yields may not always occur at these latter two levels, however, because of variations in pest population pressures and damage to the crop by the various species.

Pesticide threshold

Field studies on the influence of the number of insecticide applications on lettuce yields were conducted during the intermediate growth stage, when growers have some flexibility in their control programs. Methyl parathion and methomyl (1 and 0.9 pound active ingredient per acre, respectively) were applied two, four, six, and eight times each during the intermediate growth period. In all treatments, both insecticides were applied twice before thinning and twice following rosette formation. An untreated check was included.

Lepidopterous larval pests remained below one larva per plant during the intermediate growth period in all treatments. Plants treated with methyl parathion produced lettuce heads that weighed less than those in the untreated check. Reductions in head weight and density were correlated with the number of applications of methyl parathion that plants received during the growing season. Plants that received over three methyl parathion applications produced poorly formed (spongy) heads unsuitable for marketing as compared with the tightly wrapped heads produced in the check and methomyl plots. The percentage of lettuce plants that bolted before a marketable head formed increased with the number of methyl parathion applications (from 5 to 57 percent at 0 to a total of 12 applications during the entire growing season).

In contrast, methomyl applications were correlated with increased lettuce head weight without influencing head density. However, a positive correlation was found between the percentage of plants that bolted before formation of a marketable head and the number of methomyl applications per season, although the correlation was not as strong as under methyl parathion applications.

In additional studies at the UC Citrus Research Center, Riverside, on effects of various methyl parathion and methomyl application rates, both materials decreased lettuce leaf photosynthetic rates 24 hours after application. Reductions were of short duration, and photosynthetic rates were not significantly different from those of untreated plants four and eight days after application. However, the temporary reductions were correlated with increases in insecticide application rates. Currently, possible relationships between the suppression of photosynthetic rates by applications of methyl parathion and subsequent decreases in lettuce yield are unknown.

Pesticide-induced yield reductions are not limited to lettuce and have been reported in apples, Bartlett pears, strawberries, and cotton. Our results indicate that lettuce yield reductions caused by the application of methyl parathion resulted from reduced head weight and increased plant bolting. We calculated the total effect of methyl parathion and methomyl applications on these two factors, expressed as yield per acre, based on an initial stand density of 25,490 plants per acre (fig. 2). A maximum yield reduction of less than 7 percent was estimated for plants that received a total of 12 applications of methomyl as compared with the untreated check. Reductions of about 57 percent were estimated for replicates that received methyl parathion applications. A yield reduction of 16 percent was estimated for three applications of methyl parathion.

Summary

Provided that lettuce plants are protected during the heading stage, it is not necessary to maintain the crop insect-free during the entire growing season to achieve high yields and quality produce. Our results indicate that the season-long, low-pest-density approach may cause yield losses resulting from subtle phytotoxic properties of the insecticide applied. Density treatment levels of 0.1 and 1 larva per plant during the seedling and intermediate growth stages, respectively, should permit production of marketable lettuce while reducing the number of insecticide applications made normally.

With regard to methyl parathion applications, a pesticide threshold of no more than three applications is suggested for use on lettuce grown in southern California to avoid insecticide-caused yield reductions greater than 20 percent. This threshold may vary, depending on plant vigor and maturity, chemical adjuvants used with the methyl parathion, and environmental conditions.

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Harvest and

Jujube, or Chinese date, is a deciduous fruit tree of tropical and subtropical origin, now grown primarily in home gardens in California and Florida. Among problems that have limited development of jujube as a commercial crop in California are several factors related to harvesting and postharvest handling. These include variation in ripening time among fruits, failure of green fruits to ripen after harvest, and poor storageability of ripe fruits on the tree. To help overcome these limitations, we conducted studies on compositional changes associated with maturation and ripening and on optimum postharvest handling temperatures for transport and storage of these fruits.

Fruit characteristics

The fruit of the jujube, *Zizyphus jujuba*, is a drupe that is round to oblong in shape and varies from cherry-size to plum-size, depending on the cultivar. Its skin color changes from green to whitish green to brown during ripening. The thin edible skin surrounds a whitish flesh and a two-seeded stone. Fruits ripen in September. Later, as they dry, the fruits wrinkle and change in color from reddish brown to dark brown. They can be eaten fresh, dried, or candied.

When ripe, jujube fruits contain more sugars and less acidity than most other fruits, which give them a sweet and subacid taste. They have a somewhat pithy and relatively dry flesh, since they contain less water than other fresh fruits.

Composition of ripe jujube fruits (on fresh weight basis)

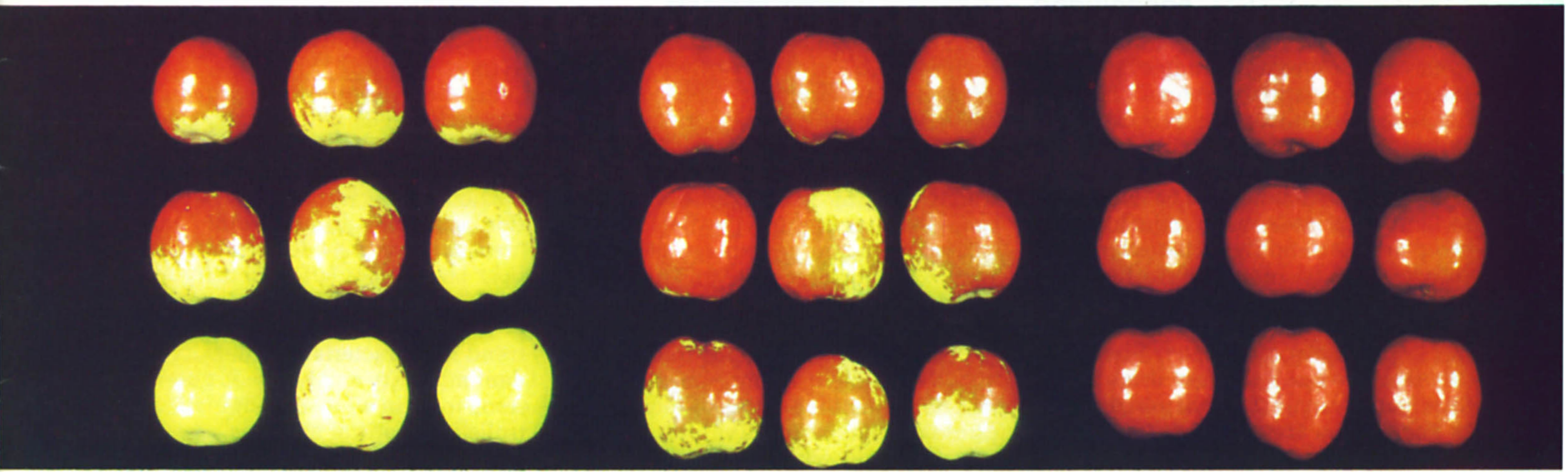
Component	Range
Water (%)	71.7-74.0
Soluble solids (%)	21.9-23.0
Total sugars (%)	20.2-21.5
Reducing sugars (%)	16.9-18.0
pH	4.68-4.71
Titratable acidity (%)	0.20-0.23
Total phenolics (mg/100 g)	270-305
Total ascorbic acid (mg/100 g)	500-560

postharvest handling of Chinese date

Adel A. Kader □ Alexander Chordas □ Yu Li

Jujube normally shrivels during drying at 20°C (right). Chilling to 0°C for 26 days caused sheet pitting, or large sunken areas (left).

Ethylene overcomes ripening problems and may enhance marketing potential



Two weeks after being picked at greenish white stage, jujube stored at 20°C shows typical uneven ripening (left). Exposure to 100 ppm ethylene for four days promoted faster, more uniform ripening (right). Fruit in center was treated for two days.

The high content of phenolic compounds is responsible for the brown color. Jujube fruits are very rich in ascorbic acid (vitamin C), which increases with maturation to more than 500 milligrams per 100 grams fresh weight. This places them near the top among all fruits as a source of vitamin C.

Fruit ripening

Fruits picked green do not ripen satisfactorily off the tree. However, if picked at the whitish green stage, they continue to ripen. Brown spots develop on these fruits and increase in size until the entire skin becomes reddish brown. The rate of color development increases with temperature and is optimum at 20° to 25° C (68° to 77° F).

Respiration rate fluctuates between 15 and 20 milliliters carbon dioxide per kilogram per hour and remains within this range while fruit is held at 20° C (68° F). Jujube fruits produce very little ethylene (less than 0.3 microliter per kilogram per hour) at 20° C, but they respond to treatments with ethylene (applied as a gas or from ethephon). Exposing jujube fruits picked at the whitish green stage to 100 ppm ethylene for four days at 20° C resulted in faster and more uniform ripening. Similar results were obtained when whitish green jujubes were dipped for two minutes in 2,000 ppm ethephon solution.

Our data indicate the possible use of ethylene treatments to attain faster and more uniform ripening of jujubes picked at the whitish green stage. This would permit once-over harvest, or at least fewer harvests, when a large percentage of the fruits have reached this stage or more advanced stages of ripeness.

Optimum storage temperatures

Fresh jujube fruits appear to be susceptible to chilling injury if held at 0° C (32° F). The primary symptom is sheet pitting, or large sunken areas on the skin. To avoid this injury, fruits should not be exposed to temperatures below 2.2° C (36° F) during postharvest handling. Fresh fruits (70 to 75 percent moisture) can be held at 10° C (50° F) for 70 days or at 20° C (68° F) for 30 days without significant quality deterioration or decay. Dried jujubes (20 to 25 percent moisture) can be stored much longer (up to a year) at temperatures of 0° to 20° C and a relative humidity of 50 to 65 percent. Such storage would permit year-round availability of this highly nutritious fruit.

Our studies thus indicate that many of the harvest and postharvest problems that now limit the potential of jujube as a commercial crop can be overcome.

Note: Information on jujube production is given in University of California Division of Agricultural Sciences Leaflet 2729, *The Jujube or "Chinese Date,"* by B. W. Lee.

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