DATES
In Arizona

pperative Extension Service —
Agricultural Experiment Station
The University of Arizona

Bulletin A-22

Contents

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The University of Arizona
College of Agriculture
Cooperative Extension Service
George E Hull, Director

Cooperative extension work in agriculture and home economics, The University of Arizona College of Agriculture and the United States Department of Agriculture cooperating Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.

7M—April 1962—Bulletin A-22

DATES
IN ARIZONA

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The Univeristy of Arizona

THE DATE has been one of the most important food plants in the desert regions of Northern Africa and Southwestern Asia since ancient times. Dates were first grown in America during the eighteenth century from seed planted by the Jesuit Missionaries on mission sites in Mexico, Arizona, and California.

Favorable reports on later seedling plantings encouraged the United States Department of Agriculture to begin importations of the better varieties in 1890. The first commercial date garden was planted in 1912, but scarcity of offshoots delayed development of the industry until 1920.

Between 1920 and 1940, about 500 acres of commercial palms were planted in Arizona with the greatest acreage in the Salt River Valley. Summer rainfall in this area has proven to be a serious hazard in commercial date production. Very high losses have occurred in 1 year, and variable moderate to light damage in 2 additional years out of every five.

Since 1945, several date gardens have been pulled out because of un-

profitable operations and many others have been sub-divided for home sites. About 200 acres of commercial gardens remain.

Many of the palms left in the home sites are well cared for and the owners harvest the fruit. Because the date palm can be grown only in the desert area, it still commands a popular general public interest.

Climatic Requirements

Successful date culture requires moderate winter temperatures, long, hot summers to mature the fruit, and little rainfall and low atmospheric humidity during late summer and fall to minimize harvest losses. In the United States, successful date culture is limited to a small desert area in southern Arizona and California.

Leaf and trunk growth is closely related to temperatures. Maximum growth occurs during the summer when leaves grow 1½ to 2 inches per day. Growth stops when maximum temperatures are below 50° F.

The heat requirements to ripen the fruit differ with varieties and range from 4200 to over 5000 summation heat units. (The sum of number of degrees of daily mean temperature above 50° F. between blossoming and ripening.) About 80 percent of the total leaf production in Arizona occurs between April 1 and October 31.

Rain and high humidity during the rapid fruit growth period (July 1 to September 1) may cause damage to the fruit by splitting the skin. Scar tissue formed during healing is referred to as "checking." Severe checking is followed by shriveling and darkening referred to as "blacknose."

High atmospheric moisture during ripening also breaks the skin. Yeasts, bacteria and fungi then enter the soft fruit and cause fermentation, souring, or decay of the tissue. Varieties differ with respect to susceptibility to damage. Good air drainage tends to reduce losses.

Palm leaves are damaged when minimum temperatures below 20 to 22° occur with durations of 10 to 12 hours. Serious defoliation occurred in 1937 and 1950 when temperatures of 14° to 17° F. occurred with durations of 12 hours below 26°.

In these freezes, the Khadrawy, Maktoom and Halaway were most seriously injured. Kustawy, Deglet Noor and Sayer were intermediate, and Hayany and Zahidi the least injured.

Botany

The date palm belongs to the family Palmae, genus *Phoenix*, species *dactylifera*. It may be distinguished from the Canary Island Palm (*Phoenix canariensis*) extensively grown in Arizona for ornamental purposes, by the presence of offshoots, a narrower trunk, and more widely spaced glaucous green leaves.

The palm is dioecious, with the male

(staminate) and female (pistillate) flowers produced on separate palms. The flower cluster (inflorescence,) is enclosed in a sheath-like case called a spathe.

The palm is a monocotyledon having a single stem (trunk) with a single terminal growth bud (shoot apex) at the top of the stem. From 18 to 26 leaves are produced each year. They develop from the shoot apex and grow slowly for about four years before they emerge above the fiber.

At this time the midrib (rachis) elongates rapidly and the leaflets (pinnae) unfold. Attached to the sides near the base of each leaf is a fiber sheath which encircles the palm and protects the tender succulent tissue at the growing point (heart).

Leaves live from 3 to 7 years. Trunk growth takes place at the top of the palm and ranges from 8 to 30 inches per year. Because it does not have a cambium layer, the lower trunk does not enlarge as the palm grows.

At the base of each leaf is a single bud (axillary bud) which is formed at the same time as the leaf. In young palms, some of these buds may differentiate vegetatively into offshoots when the leaves are about ¾ of an inch long. Several years elapse before the offshoot grows sufficiently to emerge from the surrounding leaf fiber. In old palms, these buds differentiate into inflorescences.

Buds subtended by a series of leaves which completed growth between April and October develop flower parts in early November. The number that forms flower parts is determmed by the amount of fruit produced and the leaf area during the preceding four months.

Growth of the inflorescences is slow during the winter, becomes rapid in late winter, and is completed when the spathe opens in March and April.

The root system is fibrous and similar to a corn plant. Adventitious roots about 5/16 of an inch in diameter develop from the outer part of the palm trunk and grow outward and downward. Small secondary roots develop from these main roots. While roots have been found as far as 78 feet away from palms and over 20 feet deep, about 85 per cent occur in the upper 7 feet under normal development in a deep loam soil.

Varieties

More than 100 varieties of dates have been grown by The University of Arizona Experiment Station since 1896. Only a few of these have proven reasonably satisfactory for commercial planting in Arizona.

Anyone considering the planting of a garden should make a thorough investigation of the varieties adapted to his locality. It is also advisable not to grow too many varieties in the same planting as there is considerable difference in the maturation, hydration or dehydration requirements of the different varieties.

Three Types

Date varieties can be grouped into three types: soft, semi-dry, and dry or bread dates.

Soft types have a soft flesh, a high moisture content and consequently a relatively low sugar content. Dates of

this type are highly perishable and must be kept in cold storage.

Semi-dry varieties have a firm flesh, a fairly low moisture content, and a high sugar content. Most dates of this type may be stored in semi-moisture-proof containers for months with little deterioration.

Dry or bread dates have a high sugar content, a very low moisture content and a dry, hard flesh. Very few palms of this type have been planted due to an unfavorable market.

Deglet Noor

A semi-dry date imported from Algeria. It is extensively grown in the Coachella Valley of California where it accounts for about 85% of the acreage. Fruit is very susceptible to injury from rain, high humidity and fungi. It is best adapted to light soils in the warmest parts of the desert at locations with strong air drainage. Production heavy.

Fruit: Above medium size 1¾ by ¾ inches; color: light rose, ripening to amber, curing to deeper brown; flesh semi-dry, little fiber; quality excellent; flavor distinctive; seed small; ripens late. Frequently hydrated during maturation.

Halawy

A soft variety from Iraq where it is exported to the United States and frequently sold under the "Dromedary" brand. It is seldom damaged by rain, but tends to shrivel during ripening. Less shrivel appears to occur when grown on heavy soils with adequate irrigation. Dryer fruit can be easily hydrated to a soft product. Production medium.

Fruit: Small to medium size, 1⅝ by ⅝ inches; color: yellow, ripening to light amber, curing to golden brown; flesh slightly syrupy; smooth texture; quality very good; flavor distinctive; seed medium; ripens midseason. Frequently hydrated during maturation.

Hayany

A high moisture soft date from Egypt where it is consumed fresh. The fruit is highly susceptible to rain damage which causes checking during July and August and allows fermentation and molds to develop during ripening in September. These losses can be reduced by withholding irrigations after early July. Production heavy.

Fruit: Very large size, 2⅛ by 1 1/16 inches; color: deep red, ripening to purple black; flesh coarse, soft, watery; quality good; flavor mild; seed large; ripens early. Usually dehydrated during maturation.

Khadrawy

A soft date from Iraq. It is now the principal variety commercially grown in the Salt River Valley. The palm is slow growing so its commercial life is longer than others. However, in recent years fruit has shriveled badly on palms over 25 years old. Production medium.

Fruit: Medium size, 1⅜ by ⅞ inches; color: yellow, ripening to amber, curing to reddish brown; flesh soft, becoming carmel-like; quality very good; flavor sweet; seed small; ripens early.

Kustawy

A soft date from northern Iraq. The fruit is similar to Khadrawy but smaller and more pointed. The skin tends to separate from the flesh, and the flesh frequently darkens. These disadvantages are lessened, when grown in

heavy soil. Its rain tolerance is high and by thinning heavily the sizes can be increased. Production medium.

Fruit: Small size, 1⅛ by ⅞ inches; color: yellow, ripening to light brown, curing to dark brown; flesh soft, becoming carmel-like; sometimes darkening; quality good; flavor sweet; seed small; ripens midseason. May require hydration during maturation.

Maktoom

A soft date from northern Iraq. Ripens very late when there is an excellent demand for fresh dates. Normally highly rain tolerant with little checking. Chief loss has been from shriveling of the fruit just prior to ripening. This defect has been reduced by applying fewer irrigations during May and June with no irrigations applied after mid-July. Production medium.

Fruit: Medium to large size, 1⅝ by 1⅛ inches; color, yellow, ripening to amber, curing to chestnut brown; flesh slightly granular; quality good; flavor mild sweet; seed medium; ripens late. Usually dehydrated slightly during maturation.

Medjool

A large, firm, "meaty," high quality date, intermediate between soft and semi-dry. Obtained from Morocco, it is one of the latest importations and was first planted in commercial gardens in Arizona in 1942. While the fruit is normally large, very large fruit can be produced by removing about ¼ of the center of the bunch and thinning the fruit on each strand to about 20 fruits.

Moisture content of the fruit has varied with the season, but there is a tendency to ripen semi-dry type fruits which require hydration in years when rain is below normal. Thus far, the variety has been moderately tolerant to rain damage and shows promise of becoming an outstanding commercial variety. Production medium.

Fruit: Large size, 1½ to 2 by ⅞ to 1⅛ inches, weighing up to one ounce each. Color: orange yellow with reddish brown stipling, ripening to amber, curing to reddish brown. Flesh, thick, firm, "meaty"; quality excellent; flavor, mildly rich and pleasing; seed medium to small. Ripens midseason.

Sayer

A soft date from Iraq. Many fruitstalks have an inherent structural weakness which causes them to break during early development. This has caused a large reduction in yield in some instances. When rains occur just before ripening the fruit may be seriously injured by cracking of the skin near the calyx with subsequent infection by molds. Fruit has attractive appearance and stores exceptionally well. Production low.

Fruit: Medium size, 1⅝ by ¾ inches; color, variable yellow or yellow with diffused coral red, ripening to amber, curing to brown; flesh firm carmel-like; quality good; flavor sweet not distinctive; seed medium; ripens midseason.

Zahidi

A semi-dry date from Iraq which can be handled very inexpensively. The bunches can be left unpicked until most of the fruit has ripened. The entire bunch is then cut and the fruit removed and sorted. Dry fruit is hydrated and immature fruit ripened by artificial maturation. Fruit moderately rain tolerant, stores excellently, but is generally considered to be of only fair quality. The palm is extremely vigorous. Production high.

Fruit. Medium to small size, 1½ by ⅞ inch; shape, characteristic obovate; color, chrome yellow ripening and curing to variable light brown, straw colored, or reddish brown; flavor, sweet, distinctive, improved by hydration; seed large; ripens midseason to late.

Adaptation to Soils

Many date varieties grow and produce well when grown in a wide range of soil types. Others appear to be specific in their soil requirements. It is possible that the soil type merely reflects the effects of different water-holding capacities and fertility and does not directly influence fruit quality or palm growth.

The Deglet Noor variety produces high quality fruit when grown on sandy-loam soils. In heavy soils, frequently the fruit tends to become dark, and checking is increased. In very light sandy soils, a large part of the crop may shrivel.

The Halawy, a variety that shrivels during ripening, usually produces a higher quality fruit on heavy soil than on light soil.

The Kustawy also is more successful on heavy soil.

Propagation

Dates may be propagated from seeds or from offshoots which are a vegetative part of the parent and identical with it. When grown from seeds about half will be males, and the females rarely resemble the parent. A new variety is obtainable in this manner, but after it is established, it can be increased only by means of offshoots.

Size of Offshoots

When an offshoot is 10 to 12 inches in diameter, weighs from 35 to 70 pounds after it has been pruned back for planting, it is ready for removal from the parent. At this time it usually has small offshoots growing on it and should have well developed roots.

Mounding soil around the base of the offshoot will stimulate root growth on offshoots which originate just above the ground line. This should be done about one year before the offshoots are removed.

Time to Remove

Experiments have shown that offshoots removed and planted during May and June had fewer casualties and made better growth than those planted in the late summer, fall, or winter. Offshoots do not grow during the winter months. Spring plantings take full advantage of the summer growth period.

Method of Removal

Offshoots are attached to the parent palm by a small stalk-like connection commonly called the "connection" or "neck." In removing the offshoot this connection must be severed.

A special date chisel is used to make this cut. This chisel has a rectangular cutting blade approximately 1 by 9 by 4½ inches. One side is flat and the reverse side beveled toward the sides and toward the end in such manner as to form three sharp cutting

edges. This blade is made from highly tempered tool or plow steel. It is welded to a 48-inch iron handle 1¼ inches in diameter.

Other tools necessary for removing offshoots are a 16-pound sledge, a straight-blade shovel for digging around the offshoot, a long-handled pruning hook for removing leaves, a pair of large pruning shears for trimming the top leaves and leaf bases, and heavy twine or wire to draw together the leaves of the plant.

The mother palm should be irrigated several days before the offshoots are to be cut so that the soil will be moist and easy to work.

To make it easier to work around the offshoots, remove all of the lower leaves with a pruning hook and tie the remaining ones together. Then remove the soil and locate the connection between the offshoot and parent palm. If the offshoot is well rooted the chisel can be used to cut the roots. Drive the chisel beneath the offshoot with the beveled side down. Move it from side to side allowing the sharp edges to cut the roots.

Cutting the Offshoot

After all roots are cut the connection is cut from the side of the offshoot. The chisel is set as nearly as possible at an angle perpendicular with the plane of the offshoot and the parent with the beveled side of the chisel next to the parent palm. Cut the connection as close to the palm trunk as possible, but avoid injury to the trunk.

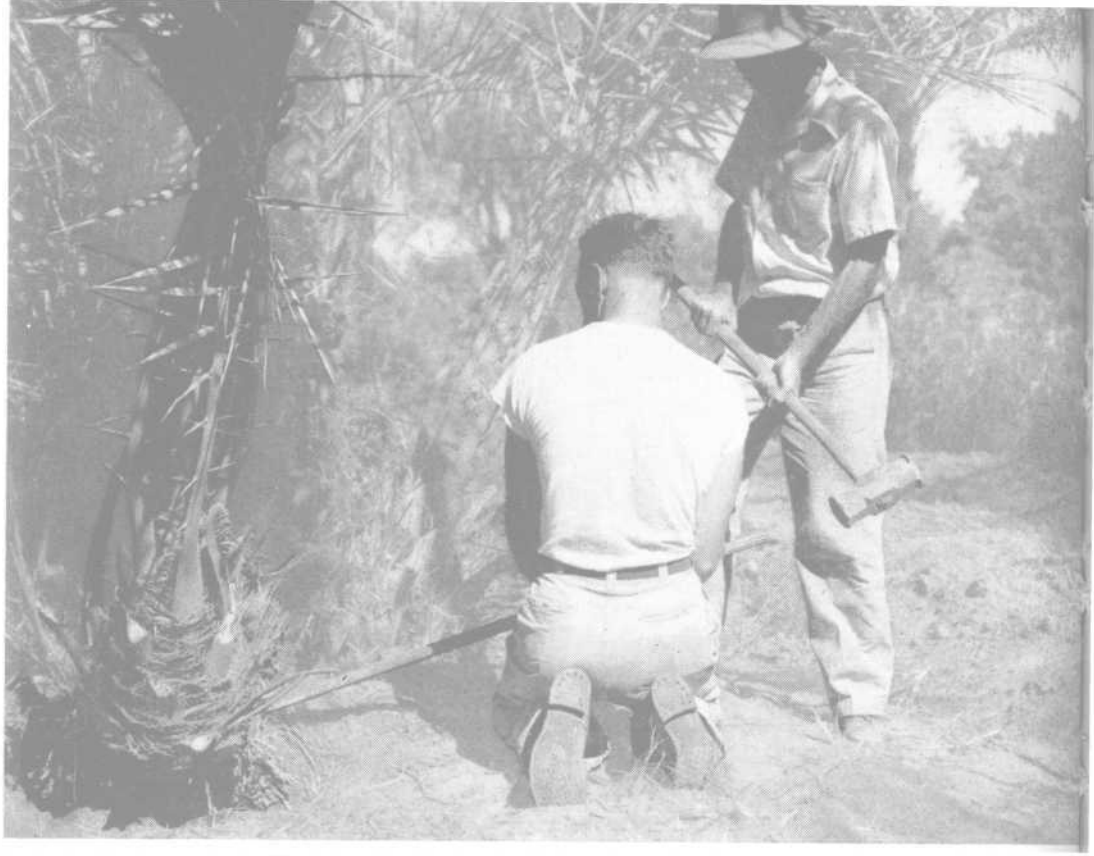
Successful date offshoot removal requires two men. (See picture page 10.) One man holds the chisel while the other drives it with the sledge hammer. After several blows from the hammer, the handle should be moved up and down to avoid wedging of the cutting blade.

If the cutting blade is hidden from view, estimate its progress by watching the movement of the offshoot. If the chisel is set below the center of the connection, the top of the offshoot will move toward the palm; if above, the movement will be away from the palm.

The first cut should be made at the side and just below the center of the connection followed by a second and perhaps a third above the first. If this does not free the offshoot, similar cuts are made on the opposite side.

When a cut is completed, the chisel is released by pulling and moving the handle up and down. Do not use the chisel as a pry until the offshoot connection is cut.

A good size of offshoot to remove. Note that the soil has been removed from the base of the offshoot, exposing well-established roots.



Two men are required in removing offshoots. One man holds the chisel while the other drives it with a sledge hammer. (Note that in the picture, the parent palm and other background have been partially masked out in order to show the offshoot in more detail.)

Surplus Offshoots

In order to obtain maximum production, the surplus offshoots should be removed from the bearing palms while they are still small, as they compete for available plant food. Removal of these offshoots from young palms also helps to bring them into bearing at an early age.

Pruning the Offshoot

After removal, the leaf stubs should be cut off close to the fiber. A small hand ax is useful for the purpose. Not more than 10 or 12 of the youngest leaves should be allowed to remain at the top of the offshoot. These should be tied tightly together about 30 inches above the fiber. Then the upper part

of these leaves are cut off evenly above the tie leaving only the lower 30 to 36 inches.

It is extremely important that these leaf tops be removed. Many offshoots are lost each year because of insufficient leaf removal. New Growth occurs only from the smaller young center leaves.

Care in Handling

Extreme care in removing and handling the offshoots is essential. Be careful not to place unnecessary strain or stress on the offshoot during the cutting operation. To drop an offshoot or give it a sudden jar may injure the heart tissue. Never handle the offshoot by its inner leaves, as the leaf bases are tender and may be broken, thereby exposing or injuring the growing tissue.

If the offshoots are to be moved a considerable distance, or if planting is delayed, cover the offshoots with burlap or similar material and keep them moist. If they are to be shipped any distance, cover the roots with wet sphagnum moss or other material of good water-holding capacity. This can be held in place with a burlap covering.

Growing Offshoots

Date offshoots are more difficult to grow than many deciduous trees and evergreens. In general, an 85 percent survival is considered satisfactory. Certain varieties usually have heavier losses. Others, notably the Hayany and Medjool, usually root readily.

The factors causing these differences are unknown. In some cases the condition of the parent palm has appeared to have a relation to the survival. Offshoots removed from an underirrigated weak parent and those cut from a very succulent, rapidly growing parent have been known to die more readily than those cut from healthy, normally growing parents. Offshoots removed in the spring following a severe freeze also have had poor survival in some instances.

Preparing Holes

For best results, especially in poor soil, prepare the holes several months in advance of planting. These holes should be about 5 feet in diameter and 3 feet deep. Fill them with a mixture of equal parts barnyard manure and good topsoil.

Irrigate the prepared holes every 3 or 4 weeks so that the organic material will be partially decomposed and the soil settled before planting time. The cost of preparing these holes is high and may not be warranted except in very poor soil.

If the holes are not prepared in advance of planting, they should be dug larger than the offshoots and filled with good topsoil. The soil should be firmed thoroughly as the hole is filled. This will prevent the settling of the offshoot after it is planted.

Planting Offshoots

Before planting the offshoot a basin about 8 to 12 inches below the general level of the ground, and 5 feet in diameter should be made around the hole. Plant the offshoot in the center of the basin to a depth just above its greatest diameter.

Work the soil in carefully around the base of the offshoot. It is best to fill the hole partially with loose topsoil and then settle it with water. Then complete the filling by working soil thoroughly against the shoot while the water is running in the hole. Air pock-

Plant the offshoot in the center of basin 5 feet in diameter. The planting depth is at the greatest bulb diameter. The stubbed leaves are protected by a burlap wrap. Place a mulch of straw or old hay in the basin to reduce moisture loss from the soil.

ets have caused the death of many improperly planted offshoots.

After planting, allow the soil to dry for a day or two and relevel the basin filling any holes which may be present around the offshoot. Irrigate again to firm the soil. Then place a mulch of old alfalfa hay, grain straw or barnyard manure in the basin to keep the soil from drying and shrinking away from the sides of the offshoot.

After planting, wrap the leaves and the upper part of the offshoot with burlap to avoid excessive drying and injury by the wind and sun. The top should be left open to allow the new growth to push out. Allow this wrapper to remain through the winter to protect the leaves from possible cold injury.

Irrigating Offshoots

During the first six weeks after planting or until new growth has started the soil surface should always be kept moist around the offshoot. This will require irrigating every 3 to 8 days depending upon the soil type, climatic conditions and the type of mulch used.

Very little water is required. Fill the basin with about 2 inches of water. Never allow the water to come up to the level of the loose fiber near the crown. If much water enters the crown of the offshoot, the succulent growing point may decay thus causing the death of the offshoot.

Planting Distance

Variety, type of soil, and climatic conditions all influence the planting distance of palms. They should be planted at least 30 feet apart or 48 palms per acre on the square system. It appears likely that wider distances are preferable for the most vigorous growing, longer leafed varieties.

Wider distances allow free circulation of air throughout the date garden, which is a distinct advantage during rainy seasons. Free air drainage carries off some of the excess moisture from the fruit and lowers the atmospheric humidity.

While the offshoots are small, the area between trees may be intercropped with fruits such as grapes, boysenberries, or apricots.

The age at which offshoots come into bearing depends on the variety, care after planting, and size of offshoot when planted. Many varieties start bearing 4 to 6 years after planting, and if given proper care, full production may be obtained in 8 to 10 years.

Management of the Date Garden

Irrigation

The date palm is a drought-resistant plant capable of surviving for long periods without irrigation. During such periods growth is first retarded and then ceases, and the older fronds gradually die. Similar to other drought-resistant plants, it uses water lavishly when ample amounts are present.

To maintain maximum growth, the soil should be wet to depths of 6 to 8 feet and no part of the root zone should be allowed to dry to within the wilting range. In sandy soils palms have been found to respond to a constant supply of water. Thus, to obtain maximum growth in young palms, heavy winter irrigations should be followed by frequent light summer irrigations.

Relation to Rain Damage

In gardens producing fruit, a problem occurs because of the susceptibility of the fruit to checking and souring during rains and when the humidity is above 90 percent. Such damage is increased if the garden has been recently irrigated. On the other hand, unless the soil moisture is maintained at a moderately high level, the size of the fruit is reduced.

The irrigation program in a bearing garden is therefore chiefly conditioned by the susceptibility of the variety to rain damage. In all cases the garden should be irrigated thoroughly during the winter and spring wetting the soil to a depth of 6-8 feet. The irrigation procedure thereafter is determined by the variety. With the Deglet Noor, Hayany, Maktoom and Sayer which are easily damaged by rains, the palms should be under slight moisture stress when irrigated in June and July and moderate stresses in August and September. This usually requires light irrigations at about 20-25 day intervals in June and July and in many instances no irrigation between early August and October. Climatic conditions and soil types vary the specific irrigation schedules.

The Halawy and Kustawy are less subject to rain damage and more subject to shrivel and blister, particularly in dry years. With these varieties best results have been obtained by irrigating frequently throughout the summer and fall.

Requirements for the Khadrawy and Medjool have not been established.

Applying the Water

Water is usually applied in furrows. However, in the Coachella Valley many growers have constructed large permanent borders in the tree row so that a large basin is formed between each row of palms. Such a program provides uniform irrigation throughout the garden and completely eliminates run off. This would be a desirable practice to use in many Arizona gardens.

It is estimated that 4 to 5 acre feet of water are required to grow palms where the soil is dry during ripening. Where heavy irrigations are continued throughout the year, 6 to 8 acre feet will be required.

Cultivation

The primary objectives of cultivation are (1) to control weeds and (2) to incorporate organic fertilizer into the soil.

Young palms should be cultivated frequently. Bermuda and Johnson grass compete severely and hold back the growth of the young palms.

Bearing palms do not require cultivation in the spring and summer except to disc under weed cover crops periodically.

During the ripening season the garden should be kept free from weeds. Weeds and grass growing under the palms at this time increase atmospheric humidity in the garden, and also make it difficult to keep the ground free of fallen fruit.

In non-tilled date gardens where oil sprays are used to kill weeds and the soil is undisturbed, the soil surface dries much more rapidly after an irrigation than it does where the soil is disked. This suggests that oil-spray weed control non-tillage may be a very desirable practice in date gardens especially where basin irrigation is used.

Fertilization

The date palm has a deep and widely spreading root system which apparently is capable of obtaining sufficient nutrients from a moderately fertile soil to maintain maximum growth and fruiting for many years after planting. Recent experiments have demonstrated that heavy fertilization with nitrogen has produced improvement in yields and growth of palms growing in previously cropped, relatively poor soils. In moderately fertile soils no response has been obtained from commercial nitrogen applications.

It appears that in most situations if the original fertility of the soil is maintained maximum growth and fruiting will follow.

Soil fertility can be maintained by growing winter cover crops of sour clover or other legumes. Barnyard manure, which is used by some growers, also maintains fertility. Old leaves are chopped up and returned to the soil in many gardens. Such practices tend to maintain the original fertility of the soil. At present this appears to be all that is required.

Removing Leaves

The leaves of all plants, by the use of their green coloring matter (chlorophyll), manufacture sugars when exposed to light. This process is known as photosynthesis.

In the palm, these sugars are used in the production of new leaves and roots, trunk enlargement, and by the ripening fruit. If more sugar is made than is immediately used, it is stored in the palm where it is changed to starch.

Analysis of palm tissue has shown that this starch reserve decreases between June and September. Apparently this is because more sugar is needed by the rapidly growing leaves, trunk and fruit than the old leaves can produce. Between October and May, the needs are less so the starch reserves are replenished.

Leaves become less efficient in producing sugars as they become older. A leaf four years old produces only about 65 percent as much carbohydrate as a one year old leaf.

Experiments have shown that about 100 leaves are required to maintain maximum fruiting. Since about 20 leaves are produced each year, leaves should be allowed to remain on the palm about 5 years. Therefore, if less than 100 leaves are present, no leaves should be removed as long as they are green, until this number is attained. If more than 100 leaves are present the number can be reduced to this amount.

Since leaves are more useful during the winter, leaf removal should be done in May. Then remove about 20 leaves if there is an excess.

On palms which have less than 100 leaves, remove only those leaves where most of the leaflets have died. Cut off

leaves, however, before the midrib dies. If the midrib is still green they can be removed easily with a pruning hook.

After the midrib dies, it is necessary to saw them off. This is an expensive operation. Leaves should be cut off close to the fiber at their base.

Cutting Spines

Each spring it is advisable to cut off the spines from the leaves produced the previous year. This is done to improve working conditions around the palm during pollinating and fruiting season. Care should be exercised not to injure the midrib of the leaf. (See picture at right.)

Pollination

Artificial pollination is necessary to insure a good set of fruit. Date palms are dioecious; i.e., female flowers which produce the fruit, and male flowers which produce the pollen are borne on different trees.

In commercial gardens the female flowers are pollinated by hand. Two good male palms will usually produce enough pollen to pollinate fifty female palms. In selecting male offshoots, select them from palms that blossom at the same time or just prior to the blossoming period of the females. Also select palms that produce many large blossoms which produce an abundance of fine, viable pollen.

Fresh Pollen Is Best

Try to collect the male blossoms within a few hours after the flower sheath, or spathe, opens. Use fresh pollen whenever possible, but if necessary pollen may be strained through a screen, air dried, and stored in a cool, dry place. Pollinate the female flowers as soon as possible after the sheath splits open.

Cut spines from the leaves to make it easier to work around the palm during the pollinating and fruiting seasons.

Pollination is accomplished by cutting the strands of male flowers from a freshly opened male blossom and inverting 3 or 4 of them between the strands of a female flower cluster within 1 to 3 days after it has opened.

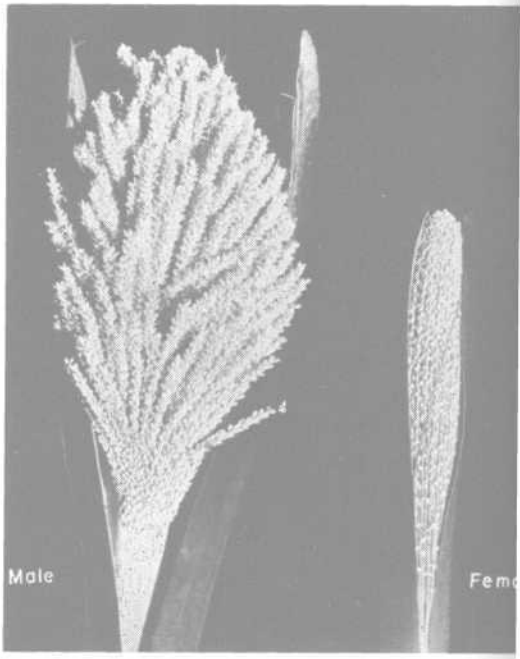
If dried pollen is used, dust it on 2 or 3 pieces of cotton about the size of walnuts and place them in the female flower cluster. Twine should be tied around the pollinated clusters

near the outer end in order to hold the male flowers or cotton balls in place. (See picture below.) This also keeps the strands of the female flower cluster from becoming entangled as the cluster grows down through the leaves.

Tie With Slip Knot

The twine is tied with a slip knot in such a manner that it will gradually loosen as the fruit increases in size. Careful pollination will usually cause from 50 to 80 percent of the blossoms to set fruit, which is sufficient for a full crop.

In some cases where pollen is plentiful, a whole cluster of male flowers may be placed in the upper part of the palm near the opening female spathes. The female flowers are then pollinated by wind or bees without any hand work.



Male and female flowers are borne on different trees. Male flower is shown on the left and the female on the right.

Polination completed. Spines removed from leaf bases, sheath cut away from the female flower cluster, and a few strands of male flowers bound in place in the center of cluster.

Fruit Thinning

The removal of a portion of the fruit from palms is necessary (1) to insure adequate flowering the following year; (2) to increase size and improve quality of the fruit; (3) to lighten the bunch and make it more open and easier to handle. It usually requires cutting off entire bunches and removing strands of fruits from the individual bunches.

Thinning should be done usually in June when the fruit is about ¼ inch in diameter. (See picture at right.)

When palms are not thinned they tend to over produce. This causes fewer flowers to develop the following year and a cycle of alternate bearing is established. To correct or prevent this condition, the smaller bunches are usually removed.

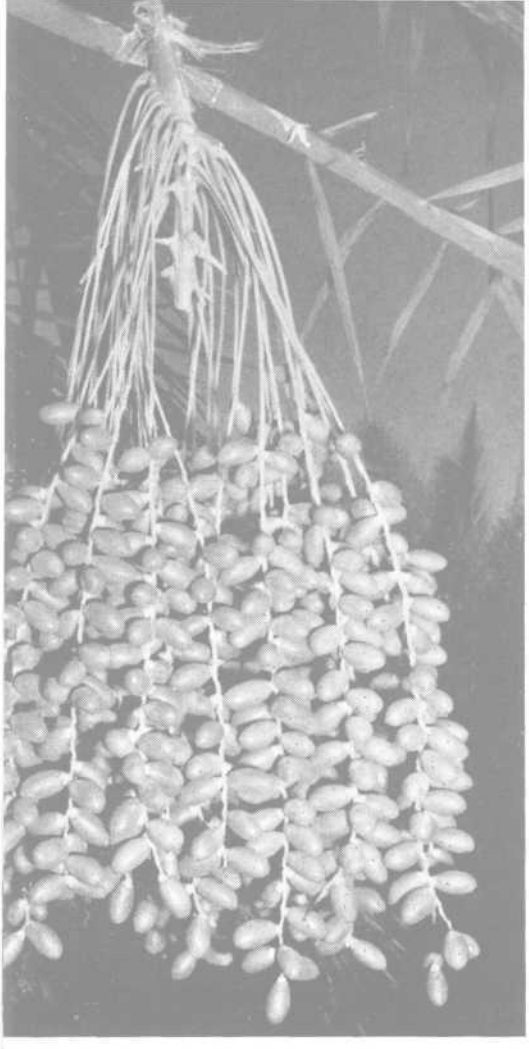
The number to be left will depend upon the number of leaves on the palm. With the Deglet Noor variety in the Coachella Valley, a ratio of

Proper stage for thinning, showing removal of the center strands.

A General Guide for Thinning

Variety	Bunch Size	Thinning Method	Remarks:
Deglet Noor	large	⅓ center ⅛ tips	checks; ferments; open bunch
Halawy	large	⅓ center ⅙ outer strands	Shrivels; keep bunch compact
Hayany	very large	¼ center	Blacknose markedly increased by heavy thinning
Khadrawy	medium	⅓ center	*
Kustawy	large	¾ center	Fruit small unless heavily thinned
Maktoom	medium	¼ center	June fruit drop thins fruit
Medjool	medium	⅓ center	*

* For highest quality fruit individual strands should be thinned to about 20 fruit.



Thinned bunch 3 weeks after the thinning operation.

one bunch to about 9 leaves, with not more than 100 to 125 leaves per palm, has been found satisfactory. A lower ratio and leaf number appears to be satisfactory with soft dates in the Salt River Valley, about 7 or 8 bunches per leaf with not over 100 leaves.

A rough estimate of the number of leaves on a palm can be easily made, since the leaves are placed on the palm in 13 columns. These columns are not vertical, but form a spiral. The extent of the spiral is characteristic of the variety. With the Iteema almost no spiral occurs, while with the Sayer the spiral is quite oblique.

To determine the total number of leaves on a palm, therefore, count the number of leaves in any column and multiply by 13.

Thin Fruit on Bunch

After the smaller bunches have been removed so that the desired leaf bunch ratio is obtained, the remaining bunches are thinned. The amount of fruit set, and the characteristics of the bunch and variety govern the type and extent of thinning. Under most conditions, from 30 to 60 percent of the fruit is removed. Usually this leaves from 700 to 1200 fruits on the bunch or from 15 to 22 pounds.

Thinning is accomplished by removing the center of the bunch and/or cutting the tips back or removing individual fruits on the strands. Thinning tends to increase damage from blacknose in certain varieties, particularly when done by cutting back the tips of the strands.

Supporting the Bunches

During the summer the weight of the developing fruit forces the bunches down through the leaves, requiring the spacing of the bunches around the palm and the bracing of the heavier ones. When the fruit has reached ½ to ¾ maximum size, the bunches should be supported to prevent the breaking of the fruiting arm, and to minimize wind damage.

The clusters are tied to an adjacent

The fruit cluster is supported by being tied to an adjacent leaf. (Note tie inside circle.)

leaf or leaves. (See picture above.) Heavy clusters may require additional thinning to lighten the weight. Do not support the bunch with a stake placed directly under the fruiting arm, as the weight of the fruit may break the stem.

Reducing Rain Injury, Fungus Spoilage, and Insect Infestation

Dates may be mechanically damaged by high humidity and rain. When rain occurs, the normal transpiration of water from the fruit is reduced so that it accumulates within the fruit.

If this happens when the fruit is small and green, the water pressure produces small cracks in the skin which heal by producing a gray colored, corky scar tissue called "checks." When extensive injury at the tip occurs, the tissue dries and becomes hard and darkened, a condition called "blacknose."

If rain injury occurs late in the summer when th fruit has turned red or yellow (the kalal stage of growth) larger deeper cracks develop which do not heal. As this fruit softens, fungi, yeasts, and acid-forming bacteria enter

The fruit cluster is tied to an adjacent leaf and covered with a waterproof paper protector. The top of the protector is tied with a tight fold to prevent water running down the fruiting arm.

the cracks and cause fermentation, souring, and decay.

Losses from fungi may be partially reduced under certain conditions by dusting the dates with Thiomate "19" (which is a mixture of ferbam in sulfur) at the time the dates lose their green color in late August.

After fruit has been damaged by rain and fungi, small nitiduled beetles commonly called dried fruit beetles *C. hemipterus* often infest the fruit entering through very small cracks in the skin or around the calyx. Control results in the Coachella Valley of California have shown that sprays, do not cause injury to dates. A spray of 2 pounds of 25 percent wettable malathion per 100 gallons of water, 300 gallons per acre, gave good results.

Also, a 5 percent malathion dust can be used at the rate of 50 pounds per acre. Apply the dust after the dates break color—from green to brown—around the last of September. One or two applications should be sufficient. Apply dusts early in the morning for best results; however they can be used later if there is no wind.

In a year when beetles are bad, sprays seem to be most effective. Apply them at the same ripening period. About the same number of applications are necessary.

Protecting the Fruit

Under certain conditions, injury from rains may be reduced by covering each bunch with a commercial waterproof paper protector. This protector is made from heavy ripple craft paper which usually contains a small amount of wax. A section of paper is sewed along one side to form a tube which is from 30 to 36 inches long.

The tube should be placed around the bunch just before the fruit starts to ripen. It is tied to the fruiting arm with a fold so that the top is tight. This minimizes the amount of water which will enter the bunch by running down the fruiting arm. The protector should extend down almost to the bottom of the bunch. (See picture above, at left.)

If high humidity prevails after the rains, it is advisable to lift the covers to allow free circulation of air around the fruit. Otherwise, excessive souring may result. Rain damage can also be reduced by placing wire rings about 8 inches in diameter in the centers of the bunches. Paper covers also protect the fruit from damage by birds and tend to reduce injuries by wasps and bees.

The extent of protection from rain varies with the seasons. If hard rains occur, protectors usually reduce the damage. If light rains with cloudy humid weather prevail, more damage may occur on protected fruit than occurs on unprotected clusters.

Harvesting the Fruit

As all the fruit in a bunch does not ripen at the same time, it is necessary to make several pickings during the season. Due to loss from insects and spoilage, most dates are picked when partially mature. To insure a high quality product, the fruit should have a high percentage of its sugar accumulated before it is picked.

When the fruit starts to ripen, it becomes translucent. That is, the flesh becomes soft and pliable and turns a light brown color. Commercially, the early maturing varieties are not picked until the entire fruit is softened. Later varieties usually are picked when they are one-third translucent. Adverse weather conditions may necessitate harvesting the fruit sooner than otherwise desired.

Dry or bread dates may be left on the palm until fully ripe and the entire cluster removed at one picking.

Removing Spoiled Fruit

Sour, over-ripe and diseased fruit should be picked from the clusters and removed from the ground beneath the palms. This helps to control insects which infest the dates in the field and which later cause trouble in the packing house.

Packing House Management

To prepare soft dates for market the following steps are involved: Cleaning and grading, fumigation, maturation, dehydration or hydration, packing and storing. A tightly screened building is required.

Special facilities include a fumigation room, curing and hydration rooms, a cleaning unit, grading belt and cold storage facilities.

Cleaning and Grading

Dates are usually cleaned by rolling the fruit over dampened toweling by means of a mechanical shaker. After cleaning, the dates are graded for degree of ripeness to facilitate maturation, and all damaged, sour or mold infested fruit sorted out. The fruit is then placed on wire bottomed trays and moved to the fumigation room.

After fumigation and maturation, it is again graded usually at the same time it is packed. Many grades of fruit can be made depending upon the date variety and type of product desired by the grower. At present a very high quality grade to be sold for gift boxes is frequently made. If the dates are to be sold as confection dates in grocery stores very little grading may be done.

Fumigation

Dates are frequently infested with insect eggs and larvae which must be killed before maturation. Dates also carry yeasts and bacteria. Fumigation kills the insect eggs and larvae and a large number of microorganisms.

Under ordinary conditions the toweling used in cleaning increases the number of yeasts and bacteria on the fruit. Therefore, the best practice is to clean and grade the fruit before fumigation and move the nearly sterile fruit directly from the fumigation room to the maturation rooms. If the maturation rooms are clean this practice will reduce fermentation losses which frequently occur during maturation.

The fumigation chamber or room should be airtight and constructed so that one door opens into the grading and cleaning room and the other into the packing house and maturation rooms. The poisonous fumes from the fumigants must be removed from the fumigation room before the fruit is removed. All fumigation rooms or chambers should be provided with exhaust fans to remove the fumes.

Two fumigants chiefly used are:

1. Methyl Bromide

This is the fumigant most commonly used by commercial date growers. Recommended treatment is 1 pound methyl bromide per 1,000 cubic feet of space. Exposure should be in a tight enclosure for at least 12 hours, and the temperature, for best results, should be over 60 degrees F.

This is an odorless gas which is highly toxic. No one should be allowed in the fumigating room until the exhaust fan has removed all of the fumigant.

2. Carboxide

This is a commercially prepared mixture containing about 10 percent ethylene oxide and 90 percent carbon dioxide. When properly mixed it is non-inflammable and less dangerous to use than methyl bromide. The recommended dosage is 10 to 15 lbs. per 1,000 cubic feet of space.

Maturation

Artificial Ripening, Hydration and Dehydration

Maturation is required because almost all Arizona dates are picked before they have completely ripened. During maturation, ripening is completed artificially and the fruit may be either dehydrated or hydrated, depending upon the variety and condition of the dates and the type of product desired.

Two general types of fruit are produced by the processors. First, a soft "flesh" date containing 35 to 42 percent moisture. This is a perishable product subject to spoilage at room temperatures. It must be kept in cold storage or sold for early consumption.

Second, a dehydrated soft or natural semi-soft date containing 25 to 28 percent moisture. In this condition the fruit does not spoil because its sugar concentration is high. Although its quality deteriorates at room temperaatures, it is considered non-perishable.

Principles of Maturation

As the date ripens, sucrose is changed to the fruit sugars, fiber is softened, tannin becomes insoluble, and water is given off. The techniques for maturation depend upon the va-

riety, season, current weather, degree of ripeness of the fruit and the finished product desired.

Insulated rooms equipped with thermostats and fans to maintain uniform conditions are used. The size of the room depends upon the amount of fruit to be processed. Heat is usually supplied from electricity, although it is possible to use gas furnaces. The temperatures used range from 95 to 130 degrees F.

Dates usually are matured in hardware-cloth-bottom trays 24 inches long, 18 inches wide, and 1¾ inches deep. Racks are built into the rooms so that the trays can be used as if they were drawers in a cabinet.

Test for Maturity

The fruit is held in the maturation room until the flesh becomes soft and most of the fibers broken down. To test for maturity, hold the fruit between the thumb and forefinger and press gently. If the flesh is soft and pliable, ripening is complete; if it is hard and unyielding, the fruit requires more time in the room.

After ripening is complete the fruit is removed if a high-moisture soft date is desired. If the processor wishes a non-perishable product, the fruit is dehydrated by further heating.

Maturation temperatures are often governed by the current weather. Higher temperatures up to 130 degrees for the highest moisture content varieties are used on relatively mature fruit following periods of rain.

High temperatures remove water more rapidly and shorten the maturation period, but usually darken the fruit. Lower temperatures (105 to 115 degrees) are used with the more inmature fruit under normal or dry conditions.

Methods of Hydration

Many varieties require hydration during maturation. Hydration can be accomplished in many ways.

(1) The most practical method which produces the best product is hydrating in the maturation room at temperatures of 117 to 130 degrees with a relative humidity of 90 percent or more for 1 to 2 days.

(2) Steam hydration in which the fruit is placed on shallow trays in a metal-lined room and live steam allowed to enter the room until the fruit temperature reaches 150 degrees. The process may be repeated until the desired moisture content is attained. Semi-dry type dates treated in this manner become sticky and syrupy and the moisture content is not uniform within the fruit.

(3) Fruit can be hydrated in cold storage (32 degrees F.) when the relative humidity is above 90 percent This is a very slow process requiring months.

(4) Placing 15 to 20 pounds of fruit in a box lined with wrapping paper and hydrating slowly at 95 to 100 degrees with a high humidity. Dates may be sprinkled with water.

A Guide for Maturation

For convenience in discussing maturation problems, Arizona varieties may be placed in three general classes:

Curing dates is an art and techniques must vary with varieties and conditions. The table (page 24) is presented as a general guide for the beginner. The ripening times are estimated to produce a moderate moisture content fruit.

Classification of Dates for Maturation

1. Soft. High Moisture	2. Semi-dry to soft. Variable Moisure	3. Semi-dry Low Moisture
Khadrawy	Halawy	Deglet Noor
Kustawy	Medjool	Zahidi
Hayany		
Maktoom		
Sayer		

Maturation Guide

Class	Condition at Picking	Ripening Temp.	Ripening Time (Hrs.)	Hydration	Dehydration
1	⅓ Translucent	95-105	72-96		yes
	Translucent	105-115	48-72		yes
	Tree Ripe	115-120	24-48	a.	a.
2	Dry Shrivel	95-105	48-96	yes	
	Soft	105-115	24-72	a.	a.
3	Dry Shrivel	95-130	24-96	yes	
	Soft Natural	No maturation			

a May require either hydration or dehydration

CLASS 1

Dates in this group are picked when ⅓ translucent to fully translucent and tree ripe.

Curing time and temperatures depend upon ripeness. Lower temperatures (105-115° F) are used when the fruit is only partly translucent. After the fruit is translucent higher temperatures (110-115° F) may be used. Tree ripe fruit can be cured at high temperatures (120° F) in a few hours or may not require maturation under certain circumstances.

CLASS 2

Fruit in this class usually varies from dry and shriveled to soft. Dates of different types should be separated. The dry and shriveled fruit should be cured and hydrated at low temperatures. The soft fruit can be cured at higher temperatures similar to the translucent fruit in class 1.

CLASS 3

Fruit in this class also may vary in moisture content. The dry shriveled fruit requires hydration. The soft tree

ripe fruit frequently does not require artificial maturation and is sold as "natural" uncured fruit. Occasionally under high atmospheric moisture conditions the moisture content of the soft fruit may be too high so that dehydration is needed.

Packing

The soft fruit is usually packed in 8 or 16 ounce paper berry baskets and covered with plastic type materials or in 8-10 ounce lithographed cartons. For the very best fancy dates all types of trays, pottery, baskets, redwood boxes or fancy cartons are used. Firm or dehydrated soft dates are also marketed in bulk in 15-pound lugs.

Cold Storage

If soft dates are not to be consumed within a few weeks, they should be placed in cold storage and kept at temperatures of 28 to 32 degrees F. or lower. Dates may be kept for long periods of time if held at temperatures around 0 degree F.

Dates may be stored at 28 to 32 degrees in the early season. If the fruit is not sold during the current season, deterioration can be reduced by transferring it to 0 degree F storage for the spring and summer storage interval. While the program increases costs, it insures a more satisfactory product the following year.

Handling and Curing Small Lots in the Home

Frequently one or two palms have been planted around a home for the purpose of producing fruit for home consumption. Commercial maturation equipment is too elaborate and expensive for maturing such small quantities of fruit.

The methods used to handle these small lots of dates are simply homemade modifications of commercial fumigation and maturation rooms. The principles of maturation remain the same as for commercial operators (page 22). Dates with a low moisture content (Class 2, page 24) are usually desired so they can be stored at room temperature.

Picking

Picking is done in the same way as the commercial operators do it, except that it is best to wait until the fruit is translucent.

Sorting

After the fruit is picked, sort carefully and discard all fruit showing fungus, skin damage, or "souring." Dates sour readily, particularly in rainy weather. Souring can be detected by the odor of the fruit.

Cleaning

Dates should never be washed in water. Instead, they should be wiped with a moist rough cloth such as a turkish towel. A convenient way to clean large amounts of fruit is to spread a moist turkish towel on a tray and spread the fruit on the towel.

Shake or roll the dates to remove dust or other forms of dirt which may be on the fruit.

Fumigation

Insects and insect eggs must be destroyed. These can be killed either with *fumigants* or by *heating* the fruit. Fumigation requires an air-tight container.

A garbage can may be converted to a home fumigator, by placing a ring of sponge rubber around the inside of the lid to form a gasket. The lid is held in place with springs. (See picture below). Other air-tight containers such as an old ice box may be used.

The fumigant is placed in a shallow dish above the trays or boxes of dates.

A garbage can made into a home fumigator by placing a ring of sponge rubber around the inside of the lid for a gasket. The lid is held in place with springs.

A mixture of three parts ethylene dichloride and one part carbon tetrachchloride is used at the rate of two-tenths of a fluid ounce, or slightly less than 2 teaspoons, per cubic foot of space. A 20-gallon garbage can contains about 2¾ cubic feet of space, so about five teaspoons of the mixture is needed. The dates should be left in the fumigator for about 12 to 18 hours.

Insects also may be killed by heating. The dates may be placed in a kitchen range and heated at a temperature of 150 degrees F. for one-half hour. (Refer to high-heat treatments, page 27.)

Maturation

Since heat is required for maturation, almost any method of applying heat to dates can be used for home curing. The authors have either used or observed the following devices and methods: (1) kitchen oven, (2) sun heater, (3) old ice box equipped with electric heat units, (4) home-made dehydrator, (5) cutting the bunch after ⅔ to ¾ of the fruit has been picked and hanging it in a warm room (80 degrees F.)

Some of these methods are adapted to only certain types of dates. The oven and the sun heater are most frequently used.

Oven Method

Spread the cleaned fruit on racks or trays one layer thick. It is desirable that the trays be perforated to allow circulation of air, but cookie sheets can be used.

The object is to heat the dates by maintaining a fruit temperature between 105 and 125 degrees. This can best be done by inserting a laboratory thermometer into a date. The oven is heated until a fruit temperature of 120

to 125 degrees is reached. It is then turned off. When the dates have cooled to 105 to 110 degrees, it is again turned on. The process is repeated until the date is soft and pliable.

If a laboratory thermometer cannot be obtained the above technique can be approximated by heating as follows: If the oven is well insulated, preheat to 200 degrees F. or low heat; turn off the oven; place dates in oven and leave them until they have partly cooled; remove the dates from the oven and repeat the process.

It is essential that the dates not be overheated. Fruit temperatures above 155 degrees cause carmelization of the sugars and impart a "scorched" flavor. High temperatures also usually produce a syrupy sticky date.

Sun-Heater Method

The sun heater is a rectangular shallow box designed to trap heat. The size of the box will depend upon the amount of fruit to be treated, so the length and width can be any dimensions. The height of the back of the box should be more than the front. It should have tight sides with a small section cut out at each end for ventilation in case the humidity becomes high. For best results a metal bottom and a glass top should be used. (A model is shown in the picture below.)

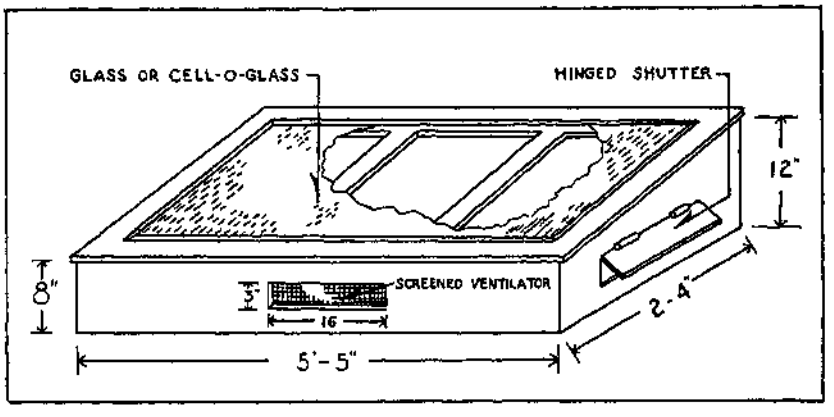
Soft dates are placed in trays one layer deep, and the trays stacked in the heater. Semi-soft dates such as Zahidi and Deglet Noor may be placed in boxes with the fruit 2 to 3 layers deep. The trays or fruit should be moved occasionally so that all fruit will receive the same exposure.

The box is placed with its sloping top toward the sun. Because the temperature may be rather low at night, ripening usually extends over a 2 to 8 day period depending upon fruit and temperature conditions.

High-Heat Treatments

After maturation is complete and the dates have dried below about 35 percent moisture, high-heat treatments

Here's a home-made date sun heater



may be used. The process usually used is to place the dates in an oven and raise the temperature of the fruit to 150 degrees and keep them at this temperature.

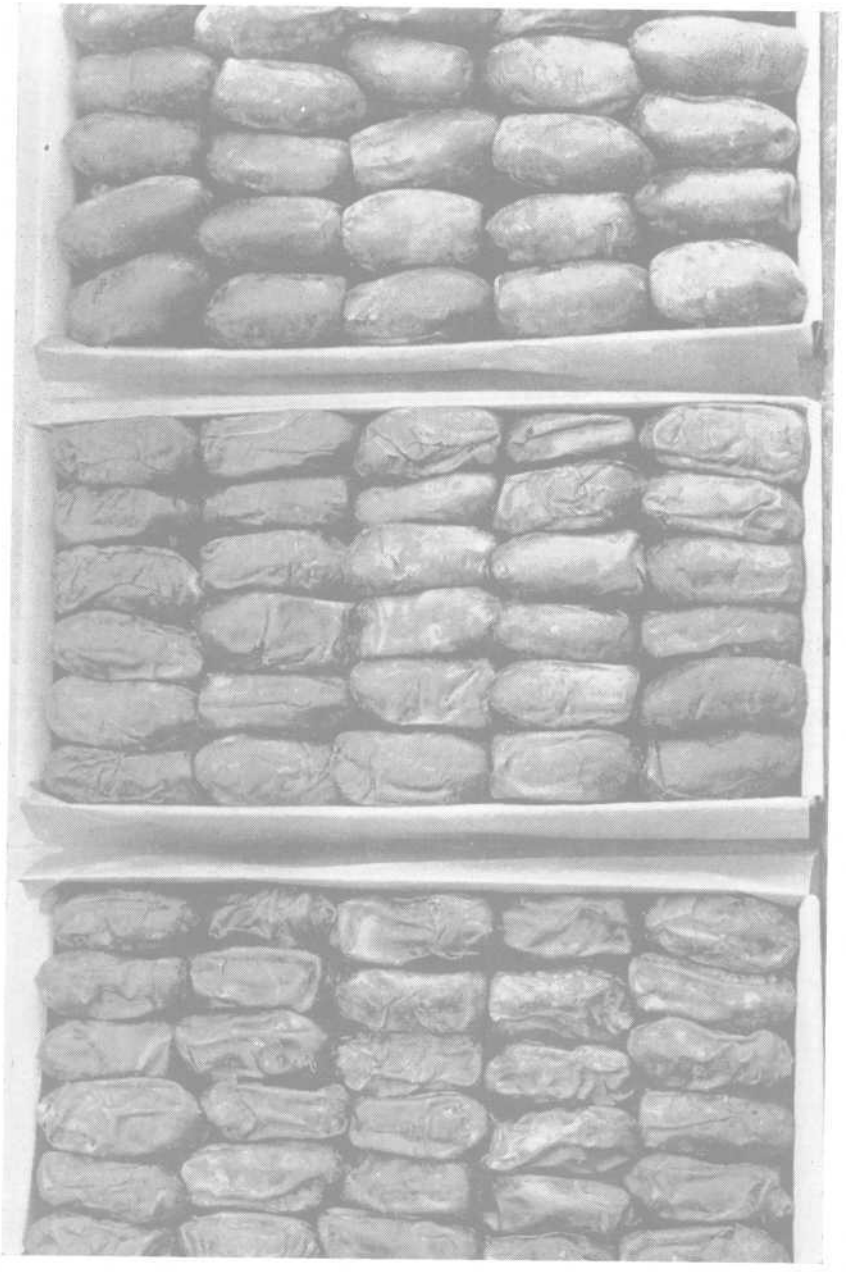
This procedure (frequently called pasteurization) kills the insects and the eggs. It provides, however, only incomplete sterilization. Yeasts are largely destroyed but mold spores and bacteria remain. This process also results in further dehydration so that the dates usually keep after such treatment.

A high-heat process also used is to can dates in fruit jars and process them in a pressure cooker using 10 pounds pressure for 15 minutes.

Storage of Dates

After maturation is complete, the dates may be placed in fruit jars, ice-cream cartons or similar semi-air tight containers. If the date is dehydrated to 20 to 25 percent no further treatments are necessary.

In cases where the moisture content is about 30 to 32 percent, high-heat treatments as described in the previous section should be used as a preventative measure against fermentation by yeasts. After the high-heat treatment, the final storage should be made in a cool dark place.



Three stages of processing on the same variety. No. 1 shows fresh dates. No. 2 is moderately dehydrated, No. 3 fully cured.

Selected for Supplemental Reading

This list of publications has been compiled by the authors for the convenience of those growers who wish to obtain more detailed information on the topics listed.

Culture (General)

*Date Culture in the United States by R. W. Nixon, USDA Circular No. 728; 1951.

Propagation

*Some Factors Influencing Growth of Date Offshoots in the Nursery Row by W. W. Aldrich, G. H. Leach and W. A. Dollins, Proc. Amer. Soc. Horticulture Science, Vol. 46, 1945.

*How Variation in Soil Moisture Affected Growth of Deglet Noor Palm Offshoots. By R. H. Hilgeman and J. R. Furr. 25th Annual Date Growers Institute; 1948.

Irrigation

*Growth and Yield of Khadrawy Date Palms Irrigated at Different Intervals for Two Years. By. J. R. Furr and W. W. Armstrong. 32nd Annual Date Growers Institute; 1955.

**Effect of Irrigation and Leaf-Bunch Ratio on Shrivel and Rain Damage of the Maktoom Date. By R. H. Hilgeman, G. C. Sharples, L. H. Howland. 34th Annual Date Growers Institute; 1957.

*Response of Deglet Noor Date Palms to Irrigation on a Deep Sandy Soil. By Walter Reuther. 21st Annual Date Growers Institute; 1944.

*The Seasonal Use of Water by Khadrawy Date Palms. By J. R. Furr and W. W. Armstrong. 33rd Annual Date Growers Institute; 1956.

Pollination

†Report Upon the Cold Storage of Date Pollen. By W. W. Aldrich. 18th Date Growers Institute; 1941.

†Size and Checking of Deglet Noor Dates as Affected by Fruit Thinning and Pollen. By Roy W. Nixon 32nd Annual Date Growers Institute; 1955.

Thinning

*Fruit Shrivel of the Halawy Date in Relation to Amount and Method of Bunch Thinning. By R. W. Nixon. Proc. Amer. Soc. Horticulture Science, Vol. 41; 1942.

*Quality of Deglet Noor Date Fruits as influenced by Bunch Thinning. By R. W. Nixon and C. L. Crawford. Proc. Amer. Soc. Horticulture Science, Vol. 40; 1942.

*How Many Fruits per Strand Should be Left in Thinning the Medjool Date. By Roy W. Nixon, 33rd Annual Date Growers Institute; 1956.

Rain Damage And Fruit Spoilage

*Checking of Fruits of the Deglet Noor Date in Relation to Water Deficit in the Palm. By W. W. Aldrich, J. R. Furr, C. L. Crawford, and D. C. Moore. Journal Agri. Research, Vol. 72; 1946.

†Date Bunch Covers and Their Relation to the Fruit Spoilage Complex of Deglet Noor Dates. By D. E. Bliss, D. L. Lindgren, W. D. Wilbur, and L. E. Vincent. 26th Annual Date Growers Institute; 1949.

**A Study of Spoilage and the Microorganism Population of Soft Dates. By G. C. Sharples. 30th Annual Date Growers Institute; 1953.

Processing and Storage

††Glazing and Hydrating Dates. By G. L. Rygg. 21st Annual Date Growers Institute; 1944.

††Factors Affecting Sugar Spotting of Dates. By G. L. Rygg. 19th Annual Date Growers Institute; 1942.

††The Relation of Moisture Content to Rate of Darkening in Deglet Noor Dates. By G. L. Rygg. 34th Annual Date Growers Institute; 1957.

**Maturation and Storage Studies with Soft Varieties of Dates. By R. H. Hilgeman and J. B. Smith. 15th Annual Date Growers Institute; 1938.

Insects

†Progress Report on Control of Date Insects. By L. E. Vincent and D. L. Lindgren. 33rd Annual Date Growers Institute; 1956.

Fertilization

*Nitrogen Fertilization of Dates—A Review and Progress Report. By J. R. Furr and W. W. Armstrong. 34th Annual Date Growers Institute; 1957.

Varieties

*Imported Varieties of Dates in the United States by R. W. Nixon. U.S. Dept. Agri. Circular 834; 1950.

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*Copies or reprints available fom United States Date Garden, Indio, California

†Reprints available from the authors, University of California Citrus Experiment Station, Riverside, California.

**Reprints available from the author, The University of Arizona Citrus Experiment Station, Tempe Arizona.

††Reprints available from the author, Dr G L Rygg — U S Dept of Agri, Agr Marketing Service — P O Box 700, Pomona, California.

Single copies and complete sets of Annual Report of the Date Growers' Institute may be purchased from the Secretary, Mrs. T. R. Brown, Route 2, Box 81. Thermal, California.

Schedule of Operations for a Date Garden

Month	Irrigation	Tillage	Palm Management
January	*	None	
February		None	Remove thorns from young leaves
March	*	None	Pollinate
April	*	Disc	Pollinate
May	*	None	Remove offshoots
	*		plant offshoots, remove old leaves
June	*	Disc	Remove and thin bunches, remove strands or berries, tie bunches to leaves
July	*	None	
	*		
August	*	Disc	Place protectors and
	a		rings on bunches
September	a	None	Harvest fruit
	*		
October	a	Disc	Harvest fruit
		Plant	
November	*	Cover crop	Harvest fruit
December	*	None	Complete harvest— remove bunches

a Extra irrigations applied to maintain a high soil moisture with varieties such as Halawy