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Foreign Date Competition

By D. H. Mitchell

STATISTICS on the amount of dates imported into this country show a rapid growth in the amount consumed in the last few years. The pre-war average for the years 1910 to 1914, according to the Commerce report of the U. S. Department of Agriculture, was 29,157,000 pounds. In 1923 we find a total of 41,733,000 pounds was brought in, which mounted to 63,607,000 pounds and in 1925 to 78,706,000 pounds. Of this total in 1925, 5,644,000 pounds is reported as entering through Pacific ports. This indicates a 23 per cent increase in 1925 over the year previous and an increase of 170 per cent over the pre-war average. Figures for 1926 were not available.

This rapid and consistent increase in consumption has been brought about with only one of the many dealers in foreign dates spending a large sum for advertising. Hills Brothers of New York have made their Dromedary Brand so well known that in many parts of the country it is the only known brand of dates. That a limit to the increase in importations is in sight however, is suggested by the following quotation from a letter from G. D. Olds, sales manager for the Hills Brothers Co.

"We estimate the present per capita consumption of all dates in this country annually at about .55 pound. In England it is well over a pound. We, therefore, figure that it should be possible to bring our per capita consumption up to that figure with reasonable effort over a period of years, which will require patience. We do think, however, that to bring this even up to this point quickly, and to bring it beyond this point at all, is going to be a matter which will require very heavy expense in both selling and advertising effort, and even that may not be successful. I don't mean that we are pessimists in the date business, because we are constantly searching for new means of developing consumer interest. We have been carrying the burden of advertising alone so long that we would welcome assistance, but we certainly think that advertising alone is not going to do it, largely because competition for the consumer's dollar is so increasingly strong from other types of food, including dried fruits.

"We have, as you can find recorded in past newspaper articles, invested some money in date growing lands in Iraq. We are frank to say, however, that we have not gone heavily into this and that we are not expanding further at this time. No attempt is being made to supply our whole requirements from our own acreage."

A large percentage of the dates imported appear on the market in the sixty-eight pound box. These are in a rather unappetizing mass but are sold in enormous quantities chiefly as a result of their low price. Dates have been the food and confection of the poorer classes for centuries and in all probability will continue to be. This being a package age, however, the tendency is away from the bulk pack and towards a handy sized carton.

In compliance with this tendency, the past few years have seen the growth of many companies who make it their business to work over these bulk dates into smaller packages. The dates are detached from the mass, cleaned somewhat, and repacked in 4, 7, 8, 10 or 16 ounce packages, usually wrapped in cellophane. The companies engaged in this work operate in many cities from coast to coast and in Canada. The activities of those in California, about a dozen in number, were subject to some criticism since the dates they packed were labeled in such a way that the ordinary customer was led to believe that they were California dates. The past year has seen the enactment of a state law requiring that the place of origin be printed on each package of dates packed within the State. This law is a real benefit to the growers of California for it insures the selling of foreign dates on their own merits.

There are many other packages of foreign grown dates on the market but with the exception of the Fard dates, also handled by Hills Brothers, they are not put out in large quantities. Some of these packages are what are called fancy packs, being put up in attractive wooden, cardboard, or glass containers and sold at prices comparable to that obtained for the best home grown dates. These are found in the most exclusive stores only, and so far at least have no appreciable effect on our market.

Figures on the tonnage of Deglet Noors that enter our country are difficult to get. The Commerce report for May 17, 1926, of the U. S. Department of Agriculture gives 372,000 pounds as the amount of dates imported from France in 1925, a decrease of 63,000 pounds from the total of 1924. It is presumed that the bulk of this fruit is of the Deglet Noor variety since Tunis and Algeria send over 90 per cent of their exports to that country and the bulk of their exports is composed of Deglet Noors.

An interesting little side light on the season just closed was discovered when reading the report of Lewis B. Haskell, Consul General stationed at Algiers, Algeria. In it he says, "The last crop (1926-27) which at the time of writing has only begun, does not promise to be very abundant. Periods of violent winds dried the dates and caused much of the fruit to fall before maturity. On the other hand the beginning of the harvest was premature." It is quite a coincidence that similar conditions should prevail on this side of the world as well.

The fact that American capital is being invested in date lands in Iraq and that Europeans are developing date gardens in Tunis and Algeria presages stronger competition from these districts at some future time. A better quality of fruit will undoubtedly be produced and an increased tonnage. Just how the market will be affected will only be known when the time comes. The North African dates are being introduced successfully into South America and it is possible that that market will absorb the majority of exported foreign grown Deglet Noors.

Production costs in this country are so much higher than those prevailing in other date growing countries that we cannot afford to sell our dates at the prices current for the foreigns. Our opportunity lies in producing a high grade of fruit that will command a profitable price. The lower grades that we produce will, of necessity, be sold at a price that

meets the full force of foreign competition while the better grades have the field almost to themselves. The moral is obvious—our growers should make every effort to produce as high a percentage of quality fruit as possible.

It has been well demonstrated that our growers can materially improve the average quality of their fruit should they so desire, though weather conditions are factors that have an important influence and are not under human control. We know that ample water is necessary, that proper thinning has its beneficial influence on the size of the fruit, that frequent picking during the harvest season is desirable, and that certain pollens produce better dates than others. Experiments with fertilizers have already demonstrated that much can be expected from that source. We have everything to gain by improving the average quality of our fruit and much to lose if we don't.

On the other hand, the future of the date industry from a marketing viewpoint never looked better. The wave of interest in dietetics and health foods that is sweeping the country is bringing a gratifying prominence to the value of dates as a health food. Our better grades have always sold readily and there has never been enough to supply the entire demand. We have never needed to advertise extensively nor has any real effort been made to develop the great eastern market for our fruit systematically. The amount of good dates that could be marketed with advertising, dealer service and educational work, is almost unlimited.

To put the matter of foreign date competition into a few words—good fruit is our safety — poor fruit our danger.

Soil Manangment in Light of the Rothamsted Experiments

By Byron J. Showers, Manager of Holmes Date Gardens

SOIL management is worthy of far more consideration than we usually give it. However, because of the many factors that must at all times be taken into consideration, a full discussion of the many possible combinations of climate, soil, water and air can not be fully discussed at this time.

Before entering into a discussion of soil and the ways and means of handling it, may I define the term. A soil is the unconsolidated but slightly cohering mass of rock fragments and secondary products derived therefrom, mixed with varying amounts of organic remains, containing some water, air and minute forms of organic life which forms the surface covering of the earth in which plants ordinarily grow. The productivity of a soil is governed by the proper combinations of these factors.

A good soil manager is an individual who exercises skillful ways and means in the handling of soils in order to obtain continuous economic returns. In one section the major way or means may be, and usually is a materially diversed problem from that of another section where totally different conditions exist.

Far too often the climatic factors are largely disregarded. In the Coachella Valley we are confronted with high temperatures and low humidity and there for high transpiration and evaporation losses. Here organic matter, if not placed below the upper six inches of soil, is quickly burned and the volatile nitrogen given off to the atmosphere. The high temperatures and low humidities are easily balanced by feeding the plant plenty of water and the selecting of plants that do well under these conditions, therefore Deglet Noor dates.

The problems evolved from the soil itself are not so general and easily solved. The underlying factors are numerous, often localized to ranches and even small spots within an acre. The ways to be employed by the soil manager will depend somewhat upon what has gone before, it will depend upon the quality and amount of tools and working capital he has with which to operate. In the irrigated Southwest the physical factors—size of soil grains and their arrangement, the amount of organic matter, soil colloids, presence or absence of the so-called alkali salts and tilth are too slightly studied by the agriculturist.

Water, when applied to the soil becomes the soil solution for it then has the soluable soil particles in solution. We often speak of this solution as soil moisture or the soil water. The soil water has two functions, that of providing the plant with the necessary water for leaf transpiration and that of forming a media in which the plant nutrients are dissolved. Plants will soon die in this arid region if they do not have soil water for leaf transpiration. the plant may live but will not prosper and bear economic crops without a soil solution of the required concentration. With dates it appears that the available soil moisture must be continuous and must not vary between such wide limits of alternate wetting and drying as many other crops. From this, and it is not a hypothesis but is fundamental, one can see that soil moisture, fertility and tilth are of prime importance. The subject of water application was dealt with at some length last year at this Institute in a paper entitled "The Economic Use of Irrigation Water" and the writer shall not repeat. We will allow the subject to pass for the present by calling your attention to the fact that soil moisture is the first and foremost essential of plant growth in soils, especially in the Southwest.

Since I am sure the program committee had the question of fertilizers very much in mind when they suggested this paper, I shall endeavor not to forget my task but before turning our attention to fertilizers, allow me to say a few words on air and is relation to soil. I believe there is sufficient evidence available to prove conclusively that the fundamenal factor underlying the results in the arid Southwest of better crops than in the more humid belts is that of better airation. Better airation, of course goes hand in hand with the availablility of plenty of soil moisture at critical times. This better airation is accomplished by frequent alternate wetting and drying where air and water are continuously replacing each other. This causes more rapid and complete oxidation of the soil particles, and sets more of the plant food elements free to go into solution. This is the basis for those of the school of thought who believe that

our problem here, at least at the present, is not one of finding the element or proper combination of elements to be applied in the form of commercial fertilizers, but is that of making more readily available to the plants those food elements already in the soil.

It seems that in this day and age, no matter what our ailment, there is always some one who has a remedy or patent medicine to sell for it. Millions have been spent by the farmers of the United States for commercial fertilizers and with what results? Some farmers have been told to return to the soil as much of each eelment of plant food as is removed in the crop. Such advice is as foolish as is the opposite statement that no attention need be given to the plant-food removed. Surely, if there is potash or phosphorus enough in the first three feet of soil to last for several thousands of years, as is often the case, it would be foolish to use potash or phosphorus as a fertilizer, unless it paid at once, and even then, one should try to find means of making use of the supply already in the soil. The view that soil water is the food of plants was tested experimentally about 1620.

This experiment is referred to in "Plant Nutrition and Crop Production," by Sir John Russell of the Rothamsted experiment station, as follows: "But the tester van Helmont, like many of us who only take part of the factors into account, drew the wrong conclusion for he completely missed the part played by the air."

Woodward, however, in 1699 found that the plant depended on something additional to water which apparently came from the soil. Some progress was made during the eighteenth century and in 1804 Theodore de Saussure made his summary but its significance was not sensed. However, long before this, farmers and scientists believed in farmyard manure, organic matter and certain mineral salts but no explanation could be given for the numerous failures and successes. But in 1834 Boussingault introduced the method of exact field experiment. "He laid out careful manured plots, weighed and analyzed the manures applied, and the crops grown and then drew up a balance sheet showing what had been put into the soil and what had been taken out by the plants." The patent fertilizer dates back to 1840 when "Liebig saw that it might be necessary always to add all of the mineral constituents" — a patent medicine if you please. This has been handed down and today we not only pay for some of the elements our soil does not require, but in addition a nominal sum for filler such as gypsum and sand and the freight on same across the nation, for most of our fertilizers come from the Atlantic coast. Liebig maintained that the crops were limited at any time by the element present in minimum amount — that a chain is only as strong as its weakest link. Here the commercial prepared fertilizer got its start and the fundamental theory behind it was an admission that the patient needed something, so we gave it stomach tablets, headache powders and liver pills in the hopes that one at least would bring the desired results. The patent manure failed, the scientific investigator was thus warned, the shrub salesman followed the hunch and the farmer has too often been the victim. Following the use of commercial fertilizers arose difficulties the greatest of which was the variation in effectiveness in soil and season. For years a certain fertilizer appeared to be of great value in one season or on one farm but had no action on another. This has led many including Hoagland, California experiment station, to conclude that "no consistent relation whatever existed between crop yields in any year and the total quantity of any element present in the soil." We find Russell's summing up statement, "In England variation is least in the case of the nitrogenous fertilizers, and the agricultural advisor is usually safe in predicting a return from them; the exceptional non-responsive soils having certain obvious characteristics which prevent his going astray. The increased crops represent less variation in recovery of the added nitrogen than might be expected, a fact that offers much interesting material to the physiologist. Phosphates and potash, however, show considerable differences in action in different conditions. Phosphates benefit cereals as a rule only on heavy soils and in cool or wet seasons; they have either no effect or a depressing effect on yields in sandy soil or in dry hot seasons." Potash fertilizers sometimes increase the yield of leguminous crops, but not of other crops except on light sandy or chalky soils.

After 81 years of continuous plot fertilization experiments at the Rothamsted station they find in numerous cases where one and the same soil sometimes responds and sometimes does not respond to one and the same fertilizer for one and the same crop. On this phenomena, Russell states, "Some seasonal factor is obviously operating and the weather conditions of 1922 differred from those of 1923 in such a way as to make potassium fertilizers of more importance in the former year than in the latter. It is abundantly proved that the soil, the climate and the plant must be regarded as a closely interlocking system and the effect of the fertilizer depends not only on the soil conditions but also on the climate," and I might add for this area soil moisture maintenance.

It is true, however, that fertilizers often modify the habit of growth or the composition of the plant. If an effect is realized one can reasonably expect phospatic fertilizers to stimulate root development in the early stages of plant growth and hasten the maturation process. Nitrogenous fertilizers, on the other hand, increase the vegetative parts of the plants (leaves and stems) and often an excess interferes with the proper setting of blooms, and decreases fruit yield. Work at Rothamsted, as well as stations in America, clearly show that the effect of fertilizers on plants depends not only on the nature and quantity of the fertilizer, the soil, the climate and soil moisture but also on the period of growth in which the fertilizer is applied to the plant.

The fact that plant nutrients can not be added alone — that they are always in combination with other elements, again complicates the issue. The potash is usually added as potassium sulphate or potassium chloride. There is a school of soil chemists who believe that the bad effects of alkali are directly due to the unbalanced relation existing between the uni-valent negative ions on the one hand and the di and tri-valent ions on the other. Therefore the addition of potassium chloride would be like adding chlorine, the main element of our so-called alkali soils and waters. Nitrogenous fertilizers are usually added in the form of ammonium sulphate or sodium nitrate. Again, because of our tendency in the West to alkali soils, the use of nitrogenous fertilizers containing sodium salts, such as sodium nitrate, would be exercising poor soil management in light of our present information. Ammonium sulphate had been used year after year for 25 years on the Wobum experiment farm when Voelcher observed the yield of barley to collapse and the crop now fails regularly. Wheat continued to grow for a longer period but is now showing signs of failure Therefore we can readily see how the physical condition of the soil may be

impaired and thereby making it impossible to get the desired water penetration so as to extract the plant nutrients already available. A cheap fertilizer, although it may give the immediate desired results, may be like a cheap shoe—which covers the foot for the time but leaves the toes permanently covered with corns. On this subject Russell warns, "The expert must ascertain the fertilizing properties with the utmost care so that farmers may have full information before making his choice." He further concludes, "The whole problem is now back again in the laboratories for reinvestigation to obtain if possible a closer approximation to the truth." With the results from 81 years experiments on the Broadbalk plot, England, and with the above warning from the outstanding soil scientist of the day, I for one will cast my money for organic fertilizers which we all know will help and can do no harm. The Broadbalk plots "show that the variation is far less on the plot receiving farmyard manure than on any of the others; it is greatest on the incompletely manured plots. The disturbing effect of weather is least marked on the plot receiving farmyard manure and greatest on the plot receiving incomplete artificials.

The mathematical treatment of these plots has emphasized the fact that farmyard manures behave differently from artificial manures and is not in fact wholly replaceable by them. The long time field experiments at Rothamsted, 1852 to the present day, show the superiority of farmyard manure to artificials, although for the first few years the artificials considerably enhanced the fertility of the soil but after a time their effect began to fall off, while the reverse was sure with farmyard manures. Similar results have been obtained with citrus fruits at the Riverside experiment station.

I do not wish to infer that the scientist should not attempt the solution of the phenomena and to elucidate the principles involved. On the contrary, in view of the fact that barnyard manures are becoming more and more difficult to obtain, there is added reason why progress should be made. While we are waiting for this information on commercial fertilizers we should be studying the purely agronomic phases such as the best ways of making, storing and using barnyard manure, the designing and establishing of rotation and green manure crops so as to increase the organic matter in the soil. It is found and generally admitted that barnyard manure greatly increases the power of the soil to take and hold moisture and to diminish the resistance of the soil to the movement of the plow. These effects are not shown, or only shown to a very small extent, by artificials, and they constitute an important reason for the superior action of barnyard manure.

We, as farmers, are not greatly interested at the present stage of development of the intricate details of the organic chemistry involved in the decaying of organic matter. Present information leads us to believe we may find, in the near future, that there is a good and a bad time to apply even organic matter, however the data available at the present time is too much under dispute to take too seriously. Organic residues greatly increase productivity of good soils though they disappear in so doing. They have less effect in sands and subsoils from which they disappear more slowly and less completely. The incorporation of undecomposed organic matter into dry soils may actually do harm. Soils, therefore, should be immediately irrigated and kept damp after an application of organic matter. The problem of tracing the course of decomposition has proven very difficult. We know that nitrates are produced, that the black structureless "humus" is formed and that complete disintegration takes place, giving rise to carbon dioxide, phosphorus, calcium, magnesium, potassium, etc., and the decomposition of other substances which are harmful to plants. This decomposition is mainly brought about by a large population of micro-organisms living in the soil. Therefore, one should not let the soil become dry, if so not for long periods of time, nor on the other hand, to keep it so thoroughly saturated with water as to exclude air, thereby killing all but the anaerobic soil organisms and thereby causing a hard, lifeless puddled soil. Micro-organisms and plants are very closely interrelated and Russell sums it up as follows, "On the one side the green plants are taking up carbon dioxide from the air and simple inorganic salts from the soil, and building them into complex organic substances rich in available energy, deriving the necessary energy for the process from the sunlight, and using their chlorophyl apparatus as the transformer — transforming very efficiently if one confines his attention to the actual chlorophast surfaces. On the other side are the soil organisms decomposing the complex organic matter to obtain the energy and nutrients they need and doing the work so thoroughly that the final residues are devoid of available energy and are simple salts which plants can utilize."

Since so much work has been done during recent years on soil micro-organisms we are sure that these little animals are very important parts of the machinery of crop production maintenance, and we are now confronted with the problem—should we introduce special organisms desired and if so, how. Inoculation has never reached an undisputed success, especially in the Southwest, although the farmer has spent considerable money mainly for canned dead organisms. We may well afford, however, to modify soil conditions in so far as we know how in order to favor or discourage the development of particular organisms or groups. But the adoption of killing methods has not reached its stage of perfection to make such treatment practical at the present time.

The much discussed subject of cultivation and the benefits derived therefrom are still in dispute among the farmers but not with the scientific men although many of the latter class are now admitting the opposite than they themselves once taught. However, we all agree that we cultivate mainly to reduce the loss of moisture from the soil, and to help the physical condition of the soil so as to make it easier to cultivate in the future and to make it take water more readily. In our attempt to reduce the loss of moisture from the soil by cultivation, we accomplish it to a more or less degree by keeping down weeds and not by building up a surface mulch to reduce soil surface evaporation. The physical condition of most soils may be improved or injured by cultivation depending largely upon the percetnage of moisture in the soil at the time the operation is performed and the type of tool used to do the job.

The coarser sandy soils are foolproof, in so far as cultivation is concerned. One must be far more careful with the fine tight soil than the coarser ones. Although the fine-tight soils are more difficult to handle, they usually are more fertile and if the soil manager is able to obtain the desired water penetration he has a smaller job to maintain economic crop production than with the coarser soil where fertilizer costs balance extra cultivation cost of the finer soils. Very little difficulty of obtaining water penetration is occasioned with the coarse soils, therefore deep, frequent, and thorough tillage is un-

necessary, while with the tight soils these operations are imperative. With many soils deep, frequent and thorough tillage make water penetration possible and therein produce economic crops. Subsoiling these soils usually results in only a temporary relief for they run right back together. In this valley we have a large amount of what might be termed "veneered" soils. They consist of a light surface coating of finely divided colloidal silt underlaid with stratified coarser materials. They are usually the more fertile soils but difficult to cultiavte and to obtain water pene'ration. They merely require more work more often.

In the end, we come back to the problem of moisture control in its relationship to plants as being the most far reaching, fundamental and important consideration with which we have to deal here in the irrigated Southwest. In practice we effect this relationship: (1) by adding more water, (2) by reducing soil solution losses by keeping down weeds and increasing the organic content of the soil and by possible modification of the colloidal properties, and (3) by the line of least resistance—adoption of a cropping system specially suited to the existing conditions.

In light of present information the following brief soil management program of date culture for the Coachella Valley might be laid out.

1. Arrange the irrigation system so that adequate water penetration may be obtained from small furrows.

2. Grow a cover-crop, preferably a legume, during the winter.

3. Irrigate the garden sufficiently heavy to satisfy the need of the palms plus the requirements of a thrifty growing cover-crop.

4. In the Spring, incorporate deeply into the soil 400-600 pounds of barnyard manure or 125-200 pounds of alfalfa hay per tree after the cover crop has developed sufficient top and root system as to be of benefit.

5. Turn the cover-crop under and again arrange the irrigation system as to assure adequate water penetration to carry the trees and mature the crop during the hot summer months.

6. Cultivate only as frequently, deeply and thoroughly as necessary to obtain best possible condition to take water.

Treatment of Dates to Prevent Souring and Fermentation

By R. H. Postlethwaite, General Manager of Valley Packing Corporation

IN the following paper I will endeavor to keep as closely as possible to the subject matter called for by its heading.

A method by which dates can be made immune to souring and fermentation seems to be the basis of all successful treatments irrespective of the question of date varieties or methods of processing or packing. There are, and probably always will be, differences of opinion on these questions, many of which I should like to take up at some future opportunity, but there can be no difference of opinion as to the vital necessity of putting a sound date on the market; sound not only when packed but after being kept for months in any place the housewife or grocer sees fit to place it.

All varieties of dates, other than possibly bread dates, are subject to souring and fermentation under certain conditions, some climatic, some physiological and some induced by improper handling. Do not misunderstand me to say that all dates will sour or ferment unless artificially treated; most dates do not suffer from these troubles, but, under certain conditions of moisture, temperature and sugar content, certain berries of all varieties will sour or ferment and it only takes one berry in a pack to disgust a consumer.

Fortunately a simple method has been evolved by which complete immunity from souring and fermentation can be obtained and I will endeavor to explain it in popular language, leaving out technicalities as much as possible.

Before going further in the discussion I offer the following definitions explaining the differences between sourness and fermentation and the agencies which cause them.

"Souring" can be defined for the purpose of this paper as decomposition of the date by micro-organisms, generally taking place when the water content is high and consequently the sugar content is low. This condition of sourness may be likened to putrifaction of meat and makes the date nauseating to the taste and unfit for consumption.

"Fermentation," as used in this paper signifies the changing of some of the sugars into alcohol, usually taking place when the water content is lower than when souring occurs and consequently the sugar content is higher. This fermentation can be caused either by enzymic action or by micro-organisms.

For the purpose of this discussion it is essential that the difference between an enzyme and a micro-organism be fully understood.

"Micro-organisms," consisting of yeast, fungi or bacteria are comparatively simple, can be seen, isolated and the effects noted. Most of us are more or less familiar with yeasts and moulds of various kinds, these are always in the air and ready to function, directly conditions are favorable.

Many of these micro-organisms are beneficial and are cultivated and used in the manufacture of alcohol and for other industrial purposes.

While they are more or less easy to kill this does not prevent others immediately beginning to function directly conditions are favorable; fortunately yeasts and kindred micro-organisms with one or two very rare exceptions, not yet found here, do not function in a medium of high sugar content of the order of 65 per cent and over.

"Enzymes," to quote shortly from a high authority, "An enzyme is the product of a living cell but acting independently of that cell; the exact nature is unknown but supposed to be of a protein character."

While no enzyme has been analysed chemically there are many known to chemists by the effect they produce. The enzyme—

"Invertase" changes cane sugar into invert sugar.

"Cytase" changes cellulose into fruit sugar.

"Diastase" changes starch into sugar.

"Zymase" changes sugars into alcohol, and so on.

What however is of real interest to us at the present time is the essential difference between enzymes and micro-organisms because on this depends the truth or falsity of the theory on which the prevention of fermentation of the date is based.

If fermentation, not souring, of the date is caused by micro-organisms no amount of treatment will prevent re-inoculation but if it is caused by enzymic action then once this is destroyed the date will remain free from further fermentation.

The theory that fermentation in the date is caused by enzymic action, with our present incomplete knowledge of the actual enzyme, cannot be directly proved, but, by a process of elimination based on experimental knowledge, it seems fair to state that the theory, at any rate, explains the proved experimental results.

The fermentation referred to in the previous definition is not likely to be caused by micro-organisms because of the natural high sugar content and evidently is not so caused because, after suitable treatment, the fermentation even if previously started does not persist or recommence as it would do if caused by micro-organisms.

Enzymic action is however strongly evidenced because after undergoing a treatment which is generally conceded as distructive to enzymic action the persistance of fermentation already started is stopped and further occurrence is effectually prevented, even when optimum fermentation conditions are imposed.

Experiment shows that the particular enzyme in the cell of the date, is easily killed by a very short exposure, probably not exceeding fifteen minutes, to a temperature of 160 degrees F.

Having stated the theory on which the treatment has been built up it seems necessary that a broader and more comprehensive view of the whole question including the question of initial sourness or fermentation be investigated.

To do this it is advisable to briefly recapitulate the history of the date, and at the present time this will only be done in general terms, not trying to differentiate between different varieties and varying conditions.

A series of analysis showed as follows:

No. 1 Berry, green, just turning to light yellow, full size.
Sugar content, 6%
Moisture content, 85%
Specific gravity, 1.0

No. 2 Berry, yellow, just turning to pink, full size.
Sugar content, 30%
Moisture content, 49%
Specific gravity, 1.022

No. 3 Berry, pink, turning to dark yellow, full size.
Sugar content, 47%
Moisture content, 36%
Specific gravity, 1.22

No. 4 Berry, fully yellow, practically same size as Nos. 1, 2 and 3.
Sugar content, 55%
Moisture content, 31%
Specific gravity 1.25

No. 5 Berry, processed and ready to pack, practically same size.
Sugar content, 68%
Moisture content, 21%
Specific gravity, 1.37

These are a typical series of analyses of the same variety and as nearly as possible similar dates in the various stages of ripening. Under normal conditions these dates would not sour. A practically constant size is maintained, the water content being rapidly changed into sugar content. If however the palm, either due to physiological, climatic or varietal conditions is not able to transform the excess moisture content into sugar in a comparatively limited time, souring will set in because the souring conditions are optimum, viz high moisture content, low sugar content and temperature about 80 degrees F., thus allowing probably both micro-organisms and enzymes to function.

If the date has soured on the palm before picking there is at present no process by which it can be made fit to pack.

There are however many cases in which dates having a moisture content of say 50 per cent and even as high as 60 per cent would certainly sour if left on the palm, but if picked before souring has actually commenced can be saved by first artificially taking the excess moisture out and then destroying the enzymes.

They will however never be high grade dates because the meat has shrunk away from the skins and the sugar content is low.

The object of this paper is to explain a "treatment which will prevent souring and fermentation" and not to overcome their ill effects after they have developed.

Experience has shown that while both souring and fermentation can be arrested by treatment and prevented from continuing, the ill flavor remains, and the date is useless for packing if it has once been allowed to sour.

At the Valley Packing Corporation's plant at Monrovia where the theory above described has been worked out, the resultant is called a sterilized date. Before describing the actual method by which this is commercially obtained I wish to say a little about the term sterilization because by some it has been confused with vacuum fumigation; the process of vacuum fumigation is for an entirely different purpose and its only effect is to destroy insect life, which it effectually does, but it does not prevent dates becoming re-infected and does not prevent souring or fermentation.

The word sterilization implies a "continued effect" and is properly applied to any article of food which has had its bacteria or enzymes effectually destroyed.

Another fallacy is the statement sometimes made that the dates during sterilization are cooked and their vitamine content destroyed. As far as I know the actual vitamine content of the date has never been systematically determined and to do so would entail a long and expensive procedure, but we do know from experiments on other food products that the temperature and time used during sterilization neither cooks the date nor does it have any effect on the vitamines which may be and probably are contained therein.

After the dates have been fumigated and cleaned the moisture content is estimated or if any doubt exits a few berries are placed in a laboratory dryer where by means of electric heat and a low vacuum all the moisture is extracted and the total percentage calculated; this does not take more than two hours and saves all guess work.

The dates to be treated are placed on 3 foot by 3 foot trays, stacked sixteen high. Each stack containing dates of similar initial moisture content. The stacks of trays are then ready to go into the Dehydrator.

Dehydrator. This is a Casey three compartment machine with a capacity of about 2,000 pounds of fruit per charge. The drying air is heated by means of natural gas, the products of combustion not coming in contact with the fruit. Experience has shown that a temperature of 150 degrees F. is most satisfactory during the drying period with a relative humidity between 30 per cent and 35 per cent; both temperature and relative humidity are continuously recorded and

are under direct control of the operature.

A curve drawn from experimental runs of average size dates shows plainly the time necessary to extract any certain percentage of water. For example, if a stack of dates contains say 30 per cent moisture and 10 per cent of this is to be extracted the trays must remain in the dehydrator six hours.

Every Dehydrator probably has a different drying curve which may be found by experiment.

The conditions which seem necessary for a suitable and efficient Dehydrator are as follows:

1st. Trays with solid bottoms with a short run of air across them so that temperature and humidity of air both on incoming and outgoing sides do not show a large difference.

2nd. Equal quantity and velocity of air over each tray.

3rd. Sufficient quantity and velocity of air not only to evaporate the moisture but to transport it.

4th. Control of both temperature and humidity.

The actual method used for heating the air to be used for drying ought to be governed by the adaptability and cost per B. T. U. or heat unit.

One kilowatt hour of electric energy is equivalent to 3424 B. T. units of heat.

One thousand cubic feet of natural gas is equivalent to 1,000,000 B. T. U.

One gallon of Pearl Oil is equivalent to 135,000 B. T. U.

With electric energy at say 2 cents per K. W. Hr.; natural gas at say 60 cents 1000 cub. ft.; and Pearl Oil at say 18 cents per gallon, the theoretical fuel cost is in the following proportions:

Electric energy	9.6
Natural gas	1.0
Pearl Oil	2.25

There is no merit per se in the use of electricity and while convenience counts for something, it is not worth the marked difference of cost even if allowance be made for the higher efficiency obtainable.

In nearly all cases gas or oil will be found much cheaper and either is very easy to regulate and less expensive to install.

After the fruit has been in the dehydrator the requisite drying time, the temperature of the circulating air is raised to 175 degrees F. and so maintained for one hour.

Careful tests show that this ensures 160 degrees F. plus in the center of the average sized date and effectually destroys enzymic action and the resultant product is entirely free from subsequent fermentation.

In 1925 Bryan Haywood brought to the packing house 47 pounds of dates, being a small sample of those damaged by the severe rain in October, 1925, and similar to those he was picking from the palms and burying as being valueless and impossible to handle.

We immediately put them into the dehydrator, took out some of the excess moisture, then processed and sterilized them, returning to him 40 pounds out of 47. Mr. Haywood reported they were in perfect condition seven months afterwards.

We have treated many hundreds of tons by the sterilization process and have yet to discover a sour date after treatment so that it seems fair to claim that one of the most serious problems of date packing has been successfully solved.

Further Evidence of the Direct Effect of Pollen on the Fruit of the Date Palm

Roy W. Nixon, Assistant Horticulturist, U. S. Department of Agriculture

IN a series of experiments in 1925 at the U. S. Experiment Date Garden, Indio, California, which were reported in detail at the Third Annual Date Growers' Institute, certain pollens were found to affect: first, the size of the seed; second, the size of the fruit, proportionately less than the seed but still significant; and third, most important of all, the time of ripening. In 1926 further experiments were conducted on a larger scale. The "Mosque" pollen, which produced large fruit and seed ripening late, was compared with the Fard No. 4, which produced small fruit and seed ripening early, in 13 experiments at the Indio station and 9 in the Salt River valley, Arizona. Including 8 field tests in various commercial date gardens in Coachella Valley these two pollens have now been directly compared in 38 experiments covering two seasons. In 27 of these experiments the pollens were applied to different strands on the same bunch. All were on Deglet Noor except one test with each of the varieties Rhars, Khadrawi, Maktum and Iteema and two on a Deglet Noor seedling. Without a single exception the results in every instance have been entirely consistent and the conclusion seems inevitable that pollen is directly responsible for the differences observed.

The increase in weight accompanying the increase in size was determined in nine experiments at Indio in 1926. The "Mosque" produced seed which averaged 49.3 per cent heavier than the Fard No. 4 and flesh, the dry weight alone of which averaged 16.4 per cent heavier. These differences were well outside the range of experimental error. With 15 per cent moisture the entire "Mosque" fruit, seed included, averaged 19.2 per cent heavier than Fard No. 4.

If it were only by some fortunate accident that "Mosque" and Fard No. 4 proved to be so diverse and no other males could be shown to vary in such proportion, the immediate practical value of these experiments would be of somewhat less consequence, for the hope of the future would be largely dependent on breeding through a long period of years. However, it is now clear that there are dactylifera males equally as late as "Mosque" and others equally as early as Fard No. 4. In 1926 along with the experiments already mentioned from one to four preliminary tests were made with more than twenty other dactylifera pollens. Three of these appeared comparable to "Mosque" and five to Fard No. 4 In fact one was a little later than "Mosque" and one a trifle earlier than Fard No. 4 and it is doubtful whether the limits of variation have yet been found. While these preliminary tests will be subject to further verification, from the consistant behavior of "Mosque" and

Fard No. 4 in every experiment over a period of two years there is every reason to believe that whether a pollen is late or early will be indicated by even a few careful tests.

No exact correlation between the size of fruit and seed and the time of ripening has been found. Yet it was apparent that no early pollens produced very large fruit or seed and no late pollens produced very small fruit or seed. An exception must be made of pollen of Phoenix canariensis, the only other species of Phoenix so far tested. One canariensis male was tested in 1925 and two in 1926. The fruit averaged slightly smaller than that of Fard No. 4 and the seed considerably smaller with a distinctive tapering base, and with two of the pollens the fruit ripened even later than that of "Mosque."

So far no differences in the fruit as regards texture and flavor have been found to appear consistently in these experiments. This applies to all of the pollens tested. The dates were carefully compared as they matured on the palm, side by side on the same bunch in most cases, and later after picking. There were some differences in individual experiments, but they did not occur uniformly in all of the tests under conditions which would permit a correlation with the pollen used. For instance in some the dates from Fard No. 4 were softer than those from "Mosque." In others the results were completely reversed. Since the "Mosque" always produced later ripening and larger fruit and seed than Fard No. 4 conditions other than pollen must have been involved.

Incidentally it should be noted that differences in time of ripening due to pollen may be indirectly responsible for apparent differences in texture by causing one set of fruit to mature during a period of lower humidity than another. Hence from a small number of experiments it might appear that one pollen was actually producing a softer date than another, while the results under other conditions with reverse fluctuations of relative humidity would be exactly the opposite.

Through the courtesy of Mr. A. F. Sievers, Biochemist of the Office of Drug, Poisonous and Oil Plants, sugar analyses were made of the fruit in one experiment in 1925 with five pollens represented, including Fard No. 4, "Mosque" and Phoenix canariensis, and in two experiments in 1926, "Mosque" and Fard No. 4 being represented in both and Phoenix canariensis in one. These analyses did not indicate any significant differences in the sugar content. The likelihood that pollen has any direct affect on the sugar of the date is further lessened by the fact that the sugar content of two samples of "unpollinated" Deglet Noor dates, one in 1925 and one in 1926, which finally ripened about three months after those which received pollen, varied less than two per cent from that of the nearest pollinated fruit.

However, the indirect influence of pollen on the quality of the fruit should not be overlooked. The size and proportions of the fruit and seed may be affected.

Abnormal seed appear to be more common with some pollens than with others. As to time of ripening the current observation of most growers is that in Coachella Valley Deglet Noor fruit ripening in the extreme heat of late summer is apt to be inferior to that which matures later during the cooler fall weather. This alone would make very early pollens undesirable for most localities in this valley, but in other sections with early fall rains or a shorter growing season an early pollen might be a distinct advantage. The maximum difference in time of ripening which has so far shown up between different pollens is from about ten days early in the season to three weeks later in the season. The effect of an early season is to lessen the difference due to pollen, while a late season accentuates it. Fruit which begins to mature in August ripens so rapidly that if the ripening begins only a week earlier the last of the crop may be off the palms a month earlier.

In 1926 a method was worked out for applying several pollens to different strands on the same bunch, which may be of interest to some growers who expect to conduct experiments of their own. This consists in sealing the pollens in small packets, about 2½x5 in., and glueing these small packets within larger bags, about 3x24 in., at the upper or sealed end. After the large bag has been placed over the strands to be pollinated and the lower end plugged with cotton and tied, the pollen is released by means of a long copper wire, one end of which is attached to a small piece of cotton sealed with the pollen in the small packet while the other end passes through the cotton plug at the base to the outside. This is not until all the bags are in position and is accomplished by holding the upper end of the bag with one hand and pulling the lower end of the copper wire with the other, which breaks the small packet and liberates the pollen, dusting it over the stigmas as it is pulled to the bottom. The small packets used were made of glassine paper, double thickness, sealed twice, and before placing within the pollination bags they were washed off in a strong antiseptic solution. The 3x24 bags were also made of glassine paper, double thickness, sealed twice, and it was possible to observe the action of the wire plunger in effecting pollination. This method eliminates the necessity for direct contact with pollens in the field. One or more pollens whose behavior is known can be prepared in this way in advance while one unknown can safely be applied in the usual way to another set of strands on the same bunch.

In making experimental pollinations it is obviously important to use female blooms which have not been exposed to any pollen. In a number of experiments in 1926 the spathes were cut and pollen applied several days before the bloom would have opened naturally. The relative size of the spathe was taken as an approximate index of maturity after blooming had begun on an individual palm. While in one or two instances there were indications that if the spathes are broken too early there may be a poor set, the results as a whole were entirely satisfactory. This is not a new idea. According to Mr. V. H. W. Dowson it is the accepted practice in Mesopotamia, cutting down the number of trips into high palms and several growers in Coachella Valley report that they have tried such pollination with good results.

The importance of saving offshoots of good male palms becomes increasingly apparent. From time to time plantings of offshoots have been made without any provision for future pollen and the large acreage not yet in full bearing will require more and more. Meanwhile seedling gardens are constantly being weeded out and very few seed have been planted in recent years. In fact it is unquestionably cheaper to buy an offshoot of a good male than it is to attempt to grow the number of seedlings necessary to produce one. Choice males are not more common from seed than are choice females. Very few possess such highly desirable physical characteristics as early blooming, an abundance of pollen

known to produce satisfactory sets of fruit, and flowers which do not shatter easily nor lose all of their pollen when the spathe first opens. Such males are valuable and when the effect of the pollen on the size of the fruit and seed and the time of ripening is determined, the grower will be able to use it with discrimination as an aid to cultural practices in producing high grade, standardized fruit.

Experiments in Storage of Deglet Noor Dates

By William R. Barger, Associate Physiologist, and A. F. Sievers, Bio-Chemist, Bureau of Plant Industry, Washington, D. C.

THE production of Deglet Noor dates is rapidly getting to a stage where the crop cannot be handled and marketed during the regular harvest season to the best advantage. The date growers have been interested in the problem of lengthening the handling and marketing period for some time and have helped the writers for several years in their study of chemical and physical changes of Deglet Noor dates during prolonged storage. We wish to thank the growers, especially those who have furnished fruit and other facilities for their cooperation.

A preliminary survey was carried out in 1923. In 1924 the crop from three locations was studied—in 1925, four locations, and since, no decided and consistent variations, due to location appeared, that could be called commercially serious; the work of this last season was confined to one location.

All fruits that would separate easily from the thread were picked and after cleaning they could be divided into several grades, or stages, three stages of green fruit, full pink, half pink, and pink shoulder were found to have their full quota of sugar, but their high moisture content and tendency to lose flavor during the time necessary to eliminate the rag and tannen, makes it difficult to artificially ripen this fruit, although it is probably not impossible. Three stages of wrinkled fruit, slightly dry with wrinkled shoulder, semi-dry, and dry present a mixture in each stage ranging from prematurely dried fruit to fruit that is tree ripened before drying progresses.

A large portion of the fruit that is easily picked, falls into a group between the green and wrinkled fruit and it is this group that we have paid particular attention to in storage. The relatively immature fruits of this group, in general, have hazel colored tip and lighter or cinnamon colored shoulder with reddish color around the calyx opening. This character we have called "color ring." The more mature fruits are darker, from hazel color over all to russet color and without any red or lavender color around the calyx opening. The texture of these fruit range from yielding shoulder with slightly soft tip to soft shoulder and tip.

Analyses of this group of fruit shows a content of 11 to 19 percent. reducing sugar calculated on moisture free basis and 29 to 37 percent. moisture. The higher percentage of reducing sugar is found in the more nearly mature fruit of this group during the early harvest season and becomes gradually less as the season advances. Inspection of this group of fruit shows that the stage having red or lavender color around calyx opening, also has varying amount of rag at the shoulder, while the stage having no red or lavender color around the calyx opening has practically no rag at the shoulder, which means that this fruit is practically fully mature on the tree.

Artificial maturation of fruit having no color ring is really needed very little, since there is practically no rag to be broken down and any trace of tannen will soon disappear. The problem of drying this fruit makes the use of 90 to 95 degrees temperature advisable, even though inversion of sugar is produced and keeping quality is sacrificed to some extent. During forty-eight hours of maturation at 90 to 95 degrees, the reducing sugar increased four to eight per cent. The loss of moisture during this time was five to eight per cent. The use of heat in the room without adding water vapor has resulted in better drying of the fruit without affecting the normal maturation. When further drying was desired after maturation, the fruit was allowed to remain on shallow wire bottom trays without heat so that circulation of air would dry the fruit with minimum inversion or increase in reducing sugar. Deglet Noor dates can be reduced to 25 per cent moisture or somewhat lower, fairly easily and this seems to be a proper balance of sugar and water to prevent mold and fermentation and still keeps the fruit reasonably moist and attractive. Fruit stored with 27 per cent moisture and more have molded and fermented freely.

The fruit having no color ring was stored in separate containers from the fruit having red or lavender color around calyx end. This division is probably not important commercially at the present time because a couple months' storage will probably take care of the crop. The storage during these experiments has been over a period of ten months and we have found very striking differences in the behavior of the fruit of these two stages of maturity during this time.

Analyses of the fruit before it was placed in storage showed 20 to 24 per cent reducing sugar; the higher reducing sugar content was in fruit with no color ring. The moisture content ranged from 23 to 25 per cent. Storage at 32 and 40 degrees has given practically the same results, so both these temperatures will be called cold storage.

After four months in cold storage, September fruit of the color ring stage, that is, slightly immature fruit, showed practically no increase in reducing sugar and with 2 to 3 per cent loss in moisture. The fruit had characteristic flavor, good color, and no objectionable amount of syrup. September fruit having no color ring and held under the same conditions showed considerable increase in reducing sugar, going as high as 33 per cent with about the same moisture loss as the other fruit. These dates were at the limit of their storage life; the flavor was slightly characteristic, but the fruit had become dark in color and considerable syrup had been formed. Late October and November fruit of both stages remained in good condition for four months in cold storage. Over this same four months period a storage temperature 55 to 60 de-

grees was successful with fruit having the color ring. September and October fruit with no color ring had an increase of reducing sugar to about 34 per cent, accompanied with flat flavor, dark color and syrupyness. November fruit without color ring remained in good condition for four months at 55 to 60 degrees.

After eight months in cold storage, fruit picked in September, October and November of the color ring stage showed only slight increase in reducing sugar and slight decrease in moisture and was attractive, had characteristic flavor and no syrupyness. September fruit with no color ring had flat flavor, dark color and was very syrupy. October fruit with no color ring had only slightly characteristic flavor and was dark and syrupy. The November fruit still remained good. After eight months at 55 to 60 degrees, the fruit of all picks having color ring showed only slight increase in reducing sugar. The flavor and color of October and November fruit was good, but the September fruit had only fair flavor and dark color. All the fruit of this temperature lost more moisture than in cold storage. The moisture content was around 19 per cent and a little too dry to be attractive.

After ten months in cold storage all the fruit having color ring showed not over 23 per cent reducing sugar and about 21 per cent moisture. The fruit was attractive, had characteristic flavor and good color. The November fruit with no color ring remained good. This late picked fruit went through the normal artificial maturation and had only 17 per cent reducing sugar at the time it was put in storage, which was comparable to the other fruit that had the color ring. All the fruit at higher temperatures had flat flavor and dark color after ten months.

The chemical change of fruit stored in bulk has paralleled that of the fruit described. The division into the stages having color ring and having no color ring was made when fruit was first picked instead of after processing. Fruit having around 25 per cent moisture stored better than fruit of higher moisture content.

In conclusion, the work indicates that Deglet Noor dates can be held 2 to 4 months in cold storage successfully and for this length of time no separation of the fruit into mature and relatively immature groups need be necessary, although elimination of over-ripe fruit is desirable. Drying the dates to about 25 per cent moisture is desirable. The color ring around the calyx opening is an indication of slight immaturity, and fruit having this color ring has longest storage possibilities, remaining in good condition eight to ten months. Late fruit of full ripe appearance stores without deterioration which is probably due to the fact that fruit maturing late in the season has less reducing sugar than early fruit of same appearance.

Chemical Studies of Dates

By M. T. Fattah, Fruit Products Laboratory, University of California

EXCEPTING the excellent and very interesting studies by Vinson of the Arizona Experiment Station, little has been published on the changes that take place during the ripening and processing of dates, particularly those grown in California. It was on this account that the writer undertook in the Fruit Products Laboratory of the University of California, under the direction of Professor W. V. Cruess, studies on some of the factors which affect the composition of this fruit.

Changes during the ripening of dates naturally and at room temperature, changes during dehydration, changes during cold storage and during storage in various gasses were studied. Tannin, total sugars, moisture and reducing sugars were the principal constituents studied.

Sugars were determined by the iodimetric method after clarification with lead subacetate. Sucrose was inverted by hydro-chloric acid.

Tannin was determined by the method given in the official and tentative methods of analysis of Agricultural Products which is that of oxidation by potassium permanganate.

Moisture was determined by drying a sample in a vacuum oven at 70 degrees C., for 12 hours.

Qualitative tests showed that all of the varieties grown in California contain considerable alcohol precipitable matter, presumably pectin.

Effect of Variety on the Composition of the Fruit

Fourteen varieties from Coachella Valley and Mesopotamia were used for these tests. For purposes of comparison, results of analyses of the mature stages only, are presented in Table I.

Some of the varieties are remarkably high in sucrose content. These varieties are classified as "cane sugar dates." All cane sugar date varieties were found to be either partially or completely mummified, while all soft dates, except soft Deglet Noor, had little or no sucrose.

Nearly all mumified or partially mummified varieties contained relatively high percentages of tannin and the soft varieties when ripe contain very little or none of this material.

Of the varieties analyzed, Ashrasi, Bedraya, Deglet Noor, Duck El Badam and Zahidi are mummified varieties. The soft form of Duck El Badam and Bedraya is not known while Deglet Noor and Zahidi can easily be obtained in soft form.

Immature dates of all varieties contain relatively large amounts of sucrose and tannin. These substances gradually decrease as the fruit matures, and disappear in some varieties. Table I, indicates a correlation between the content of sucrose and tannin in mummified dates. Although considered mature by the general public this correlation suggests that they are chemically immature.

The presence of a high percentage of sucrose and tannin in the mature Deglet Noor may be considered an exception to the ripening phenomenon. The precipitation of tannin and the inversion of sucrose in dates are probably due to internal enzymes —the amount and activities of which are different in different varieties. These enzymes are present in Deglet Noor but they are inactive as shown by Freeman.* Their stimulation by heat or chemicals will probably cause complete inversion of the sucrose and precipitation of the tannin.

The Arabs classify dates as "cold

dates" and "hot dates." Hot dates usually being considered the sweetest. Sweetness is considered by most people as being due to a high total sugar or sucrose content. My results indicate that there is no correlation between "hotness" and high total sugar or sucrose content. Zahidi which is considered one of the sweetest and hence called a hot date, has on the average 80 per cent total sugars and from 0.75 per cent to 13.11 per cent sucrose, depending upon whether it is mummified or soft. On the other hand Maccawi has 81.2 per cent total sugars and no sucrose; Ashrasi has 73.3 per cent total sugars and from 5.0 to 8.0 per cent sucrose and Bedraya 79.1 per cent sugars and 16.24 per cent sucrose yet these three varieties are considered cold dates.

It is possible that the kind of sugar rather than its amount causes a date to be "hot" or "cold." It is well known that honey which consists largely of levulose is sweeter than cane sugar, while Karo syrup which consists largely of dextrose is less sweet than cane sugar. There is a possibility that the invert sugar of some dates consists largely of levulose causing them to be classified as hot dates. This is merely a theory but it may arouse the interest of someone to test its truth or falsity.

Effect of Stage of Maturity on the Composition of the Fruit

Fruit from Coachella Valley only was used for these tests. Three stages of maturity were selected arbitrarily, as follows:

1. Green or immature stage—the stage at which the fruit begins to change color. This is the stage that the Mesopotamian growers call "Khalal" and which Freeman in his experiments on ripening called "mature green."

2. Medium ripe stage—the stage at which the fruits lose nearly all of their astringency and color which characterize the previous stage, acquiring a softer texture and a darker, less attractive color. This is the stage at which dates are sold for fresh consumption in Mesopotamia. It is known as "Retab" in that country.

3. The mature or ripe stage—the stage at which the fruit contains the maximum amount of total solids. This stage is known by the Mesopotamian grower as "Tamour."

Analyses were made of six varieties at different stages of maturity. They were very similar in each case with the exception of the Deglet Noor. Results for three varieties are presented in Table II.

Samples of Deglet Noor did not well represent the different stages of maturity and it is therefore the writer's belief that not too much importance should be attached to these results. They are presented merely for the sake of comparison.

An examination of Table II shows that in the green stage all the soft varieties contain appreciable amounts of sucrose, while in the ripe stage they contain little or none of this sugar. Deglet Noor which may be classed as semi-soft always contains appreciable amounts of sucrose which appears to increase in amount as the fruit matures. Certain of the Mesopotamian varieties also contain appreciable amounts of sucrose when ripe (Table I).

Tannin gradually decreases in amount as the fruit matures. The fact that the ripe form of Zahidi contains less sucrose, no tannin and more total sugars than its mummified form may support the hypothesis of chemical immaturity of the latter form.

Effect of Locality on the Composition of the Fruit

In order to determine the effect of locality upon the composition of the fruit the very ripe form of several varieties were obtained from the Coachella Valley and Mesopotamia for analysis. The results of some of these analyses are presented in Table III.

Dates from different sections of the same general locality as for instance Halawi from the Tropical Date Co., and from the Government Date Garden show little difference in composition. Fruit grown in Mesopotamia appears to have a higher total sugar and reducing sugar content and in general less tannin and sucrose than the same variety grown in Coachella Valley.

This may be due to slightly higher summer temperatures in Mesopotamia and also to the fact that the

TABLE I

EFFECT OF VARIETY ON COMPOSITION OF FRUIT

Sugar and Tannin in per cent of dry weight
Seed and Moisture in per cent of fresh weight

Variety	Maturity	Locality	Seed	Moisture	Reducing Sugar	Sucrose	Total Sugar	Tannin
Ashrasi	Mummified	Mesopotamia	6.0	13.9	66.90	5.98	73.20	0.59
Azrak El Azrak	Soft	"	11.0	15.7	69.30	0.28	69.60	0.00
Banawsha	Semi-Soft	"	15.0	15.1	65.60	2.09	67.69	0.00
Bedraya	Mummified	"	10.1	12.3	62.00	16.24	79.10	0.69
Barhi	Soft	Tropical	11.2	19.7	72.53	0.38	72.93	0.00
Degal	Semi-Soft	Mesopotamia	12.6	14.1	59.20	1.62	60.90	0.00
Deglet Noor	Mummified	Tropical	9.0	20.3	42.00	28.46	71.90	0.02
" "	"	Gov't. Garden	9.5	26.4	40.23	30.06	71.83	0.01
" "	Soft	" "	10.0	18.4	38.20	42.72	82.70	0.2
Duck El Badam	Mummified	Mesopotamia	18.2	10.4	39.00	26.40	66.80	1.8
Halawi	Soft	Tropical	11.8	21.6	72.62	0.25	72.88	0.00
"	"	Gov't. Garden	12.0	19.9	73.52	0.15	73.67	0.00
Khadhrawi	"	Mesopotamia	9.6	13.9	74.20	0.00	74.20	0.00
"	"	Gov't. Garden	9.2	15.4	72.12	1.25	73.43	0.02
"	"	Tropical	9.14	31.6	70.63	2.36	73.11	0.05
Khastawi	"	Gov't. Garden	12.6	14.6	72.13	0.53	72.66	0.00
"	"	Mesopotamia	11.0	15.5	77.20	1.52	78.80	0.00
Maktum	"	Gov't. Garden	10.45	17.5	72.15	0.34	72.50	0.00
"	"	Mesopotamia	10.7	15.1	80.20	0.00	80.20	0.00
Maccawi	"	"	8.6	15.7	81.20	0.00	81.20	0.00
Zahidi	Half Mummified	Tropical	12.5	17.7	74.25	1.63	75.95	0.00
"	" "	Gov't. Garden	11.8	15 6	72.32	1.50	73.89	0.00
"	Mummified	Mesopotamia	11.2	14.4	66.80	13.11	80.60	0. 23
"	Soft	"	11.7	17.7	83.40	0.76	84.20	0.00

fruit is allowed to remain on the palms until dehydrated and ready for packing.

At the request of Mr. Robbins Russel, manager of the Tropical Date Garden, I devoted considerable time to an investigation of artificial ripening of dates.

Three means were used for ripening of immature dates: (1) Heat. (2) Organic vapors. (3) Gasses.

Immature Barhi ripened in an incubator at 130 degrees F., for 48 hours yielded dates of good flavor and low tannin content. The color, however, changed from light yellow to amber. The same variety ripened in a dehydrator at 120 degrees F., for 36 hours yielded fruit of lighter color and firmer texture. Both treatments caused complete precipitation of tannin and almost complete inversion of sucrose.

Immature Barhi placed in carbon dioxide gas ripened completely in 48 hours. The product was better in appearance and flavor than the same variety ripened with heat. Sucrose was inverted to a less extent.

Immature Halawi placed in oxygen ripened in 96 hours. The flavor was good but oxidation of the tannin caused the fruit to darken considerably.

Immature Khadhrawi was exposed to vapors of nitrous ether, alcohol, chloroform, carbon bisulfide and acetic acid. In all cases the dates ripened and were pleasing to the eye, but were unpalatable or inedible due to their impregnation with the organic fumes. No attempt was made to rid the fruit of these vapors before sampling. Had this been done it is probable that little or no impairment of flavor would have been noticed, at least in some of these cases. In all cases tannin was precipitated and sucrose was inverted although to a less extent than in fruit ripened by heat, carbon dioxide or oxygen. Heat and carbon dioxide appear to be the two most practical means of ripening immature dates to produce a fancy and wholesome product.

At the request of Mr. C. E. Cook of the Deglet Noor Date Growers Association, green Deglet Noor dates with a tannin content of 1.16 per cent were placed in cold storage in sealed jars in order to determine the effect of low temperature on tannin content. Samples were placed at 32 degrees F. and 0 degrees F. After 40 days storage the fruit kept at 32 degrees F., had a tannin content of 0.5 per cent a decrease of 57 per cent; while that kept at 0 degrees F. had a tannin content of 0.92 per cent or a decrease of 20 per cent. An explanation of this behavior is difficult. It would seem, however, that although the ripening processes are retarded they are not completely stopped at low temperatures or that the changes determined took place while the fruit was thawing.

TABLE II

EFFECT OF STAGE OF MATURITY ON COMPOSITION OF FRUIT

Sugar and Tannin in per cent of dry weight
Moisture in per cent of fresh weight

Variety	Maturity	Moisture	Reducing Sugar	Sucrose	Total Sugar	Tannin
Barhi	Green	53.8	35.89	16.40	53.15	1.64
	Medium ripe	27.8	46.93	15.80	63.56	0.1
	Ripe	19.7	72.53	0.38	72.93	0.0
Deglet Noor	Green	42.2	12.60	28.50	41.10	1.9
	Medium ripe	29.3	24.70	28.22	54.40	0.21
	Ripe	18.4	38.20	42.27	82.70	0.2
Halawi	Green	52.5	22.20	6.26	28.78	0.5
	Medium ripe	27.0	58.57	1.12	59.74	0.0
	Ripe	21.6	72.62	0.25	72.88	0.0

TABLE III

EFFECT OF LOCALITY ON COMPOSITION OF FRUIT

Sugar and Tannin in per cent of dry weight
Seed and Moisture in per cent of dry weight

Variety	Locality	Seed	Moisture	Reducing Sugar	Sucrose	Total Sugar	Tannin
Halawi	Tropical	11.8	21.6	72.62	0.25	72.88	0.00
	Gov't. Garden	12.0	19.9	73.52	0.15	73.67	0.00
Khadhrawi	Tropical	9.14	31.6	70.63	2.36	73.11	0.05
	Gov't. Garden	9.2	15.4	72.12	1.25	73.43	0.02
	Mesopotamia	9.6	13.9	74.20	0.00	74.20	0.00
Khastawi	Gov't. Garden	12.6	14.6	72.13	0.53	72.66	0.00
	Mesopotamia	11.0	15.5	77.20	1.52	78.80	0.00
Maktum	Gov't. Garden	10.45	17.5	72.15	0.34	72.50	0.00
	Mesopotamia	10.70	15.1	80.20	0.00	80.20	0.00

Summary and Conclusion

1. Different varieties differ widely in their chemical composition.

2. All "cane sugar" dates studied were found to mummify.

3. Mummified dates are considered to be chemically immature.

4. All soft varieties contain little or no tannin or sucrose when fully mature.

5. "Hotness" and "coldness" of dates may possibly be correlated with their content of some specific reducing sugar — levulose is suggested.

6. No correlation was found between the sucrose or total sugar content and sweetness.

7. In general, ripening involves a decrease in sucrose and tannin and an increase in reducing sugars.

8. Dates grown in Mesopotamia had a higher content of total sugars and reducing sugars and in general less tannin and sucrose than those grown in California.

9. Heat and carbon dioxide appear to be the best agencies for ripening immature dates.

10. The tannin content of immature dates placed in cold storage decreases.

Finally, the writer wishes to thank Mr. Robbins Russel, manager of the Tropical Date Garden, Mr. C. E. Cook, President of Deglet Noor Date Growers Association, the Government Date Garden and Fattah & Sons of Bagdad, Mesopotamia, for providing samples of dates which made possible the conducting of these experiments.

*Vinson, A. E., and G. F. Freeman, 1910. Artificial ripening of dates, Arizona Sta. Bull. 66. 403-450.

Date Marketing--Present and Future

By Burdette K. Marvin

DATE marketing of the present and future is affected by the date marketing of the past. Because the industry was young the methods of packing and selling were not standardized. Had dates gone out in uniform quality for immediate use as a fresh fruit, or for use as a dried fruit, as figs are used both fresh and dried, or for use as a confection, so that those three uses could have been established in the consumer's mind, then our present marketing problem would not be so complicated as it is today. Prior to the development of our date industry, people of this country had been accustomed to purchasing dates as a dried fruit only. Obviously it takes a big sales effort to change popular conception of this product. The fanciest dates elaborately packed in fancy containers, going out as a confection, competing with fine candy, sold naturally at a dollar a pound, sometimes more. It is an open question if the injury to our market through this 'dollar a pound" idea has not been greater than the value of all the dates we have sold in the fancy packs. The main offsetting consideration is the advertising gain through distribution of these fancy boxes ;the spreading of the knowledge that California raises dates. The 'dollar a pound" incubus is to hamper us for a long time to come. Last week a wealthy man complained to me because of this price for dates. If only we could make it known that good dates are obtainable at the price of the finest figs, walnuts, almonds, often at less than eggs or butter, that, as a food, they are worth quite as much as these other foods pound for pound, then we should have, I believe, a buying power practically unlimited. At this time of increasing wealth throughout the country, there should be no difficulty in marketing a clean, wholesome and enjoyable product like ours in our small quantities.

If this section raises a million pounds of dates on an average of but, say, three thousand pounds per acre, what will be our production when we get our ideas corrected to ten thousand pounds per acre? What will we do with three million pounds of dates, or five million? Well, that is a very small quantity compared with our imports. In 1925 we imported 75,000,000 pounds; more in 1926.

These importations are rising, and methods of packing imported dates are being improved, as you have just heard from another speaker. I received a letter from Mr. Dowson, of Hills Bros., whom many of you, doubtless, remember as being here last Institute. He said that the crop at Basrah was scarce and prices high, and he thought it likely prices were affected here. I do not think that anyone engaged in selling California dates noticed any such effect. The production of the Iraq is so vast, compared with ours, that it is hard to imagine any conceivable change there affecting our market for California dates very much. Mr. Dowson told me their crop in 1925 ran about 800,000,000 pounds; and dates are raised in a dozen other countries. It is time for us to advertise our dates, not at a dollar a pound, but as low as we possibly can on a profitable basis. For that reason we must get away from the three thousand pound per acre idea and lay fast hold of the ten thousand pound per acre yield as our basis of profit. Two main difficulties in selling California dates: one, the cost of producing, which automatically puts up the price of selling; and, two, the really dreadful variation in the dates offered for sale, and the helplessness of the trade, even when willing to handle this unknown product advantageously. It is, probably, the experience of every salesman to find dry, slow-moving dates on the grocer's counter and to be unable to sell that grocer attractive dates until the old stock has moved out; and the continuing mystery remains, why the grocer stocks up with this date which, however good for food, will sell only about the ratio of one to one hundred of attractive dates such as we have generally to offer. I have here a number of packages of dates which I have bought recently at good stores or better. These are not the original packs and I show them only to make clear to you that we are attempting the impossible when we try to increase consumption of our dates with offerings like these. The buyer for a large chain store in Los Angeles told me he was not interested in California dates after Christmas as they would not sell; but he did take on a few pounds from somebody else. The good man is right. California dates, such California dates as he bought, will not sell. (Oh yes, of course they sell to food faddists and more or less here and there: but they will not sell in thousands of pounds. If we cannot figure sales in thousands of pounds, we cannot do much business, evidently). Now this complaint of the other fellow's dates is, probably, as old as date growing; but it is quite a marketing factor. The trade are absolutely fed up with basket dates which ferment or get messy, with dates that look rather well but are too dry to be palatable, with the whole lot of stuff that might be tolerated if it were cheap and moved fairly fast, but is a loss (which smart grocers will not sustain) in the counter space it takes, account slow movement.

I have said that we should put our dates out as cheaply as we could commercially; that is, leaving a profit on every part of the transaction, raising and packing. I used to think that we had but to extend the knowledge of the date to other sections to increase our market to the size of the market in Los Angeles territory. I am inclined to think that making the date popular away from its own country is not so easy an undertaking. Theoretically, wealthy people in Chicago, New York, or Washington will buy these dates regardless of price as soon as they know their beauty and delicacy; but in seven years' effort I have not seen much to encourage such a theory. Evidently, the effort has been too feeble. How can it be anything but feeble with an industry so thoroughly disunited as ours?

In the book of Job we read, "If I were hungry, I would not tell thee; if I were thirsty, I would not tell thee." If I wanted to know anything about a grower's pack, he would not tell me; if I wanted to know if he was marketing his dates

successfully, he would not tell me—the truth. Last November, to give an individual instance, I wanted to buy five thousand pounds of soft dates, Khadhrawi or seedlings, any dates of soft skin. I failed to get them. Particularly I remember that one grower told me he had such dates, but only ten thousand pounds, and he had them all assigned to certain markets. He also said he was sending them east and getting four to five dollars a crate net. Yet his dates I saw in San Francisco retailing at 15c an 8-ounce basket; yes, and two baskets for a quarter. Such selling does more than a little to upset our date market. Two baskets for a quarter is only 12½c apiece. With retailer's profit say three cents, commission 10 per cent, or .9c, expressage 2.8c, packing and container 2½c, total deduction of 9c, leaving only 3½c a half-pound, or 7c a pound, to cover raising, picking, stocking, handling, curing, and last but not least, shrinkage resulting therefrom. This was not the fag end of the season when goods were discounted, but in the late fall. Now, that is a price lower than I advocate because it does not leave margin of profit for raising or packing. I cite it only as being an extreme instance of the sort of difficulties all sellers face, the unsettled condition of the market due to lack of standardization in quality, packs and prices.

I am going to give a bit of my own experience, rather regretfully because in this Institute there should be nothing like advertising; but there are so few houses packing dates and they differ so radically in their fruits and methods, that there are, really, no examples from which we can speak generally. Now I mentioned the disappointment in developing the market in other territory. I think, probably, my whole trend has sounded disappointed and dubious. Well, here is something on the other side, affording I think, evidence of the soundness of our belief that, handled according to sound business principles, our dates can be sold much more than hitherto. It was three years ago that I undertook to market dates in volume after Christmas. Before that I had done just as was generally done, held my crop for the holidays and cleaned up afterwards. But in 1924 I deliberately stocked thousands of pounds of dates for sale after the Christmas holidays. Of course, I was told by one merchant after another that dates would not sell after Christmas. But the dates won out, and we sold a greater poundage after Christmas to the first of July than we had sold in the preceding six months; and, since then, we have done increasing business after the first of January. This year to date about 55,000 pounds, and estimate to the end of the season 75,000 pounds or more. Now, I submit that such sales are possible only if the goods are desirable, and the price is attractive. That sounds like platitude. But, lower your price all you please, you could not move any such tonnage, in my belief, if your dates were unattractive in appearance. The more attractive your dates, the higher you can maintain your price and volume obviously. The tonnage quoted indicates that we got a fairly practical combination of quality and price.

In conclusion, I would say that date marketing of the future should be given more and more into the hands of those experienced in selling. For every date raiser to think that he should be the salesman for his own crop is only to prolong the unsettled conditions of our date market. We must get away from thinking of dates in case lots and hundreds of pounds. If we cannot think in ton lots, we cannot develop a business worth the effort that is being made in our valley on our new crop, the world-old food-fruit, dates.

-:- Resolution -:-

BE IT RESOLVED BY THE MEMBERS OF THE FOURTH ANNUAL DATE INSTITUTE HERE ASSEMBLED:

First—That we hereby express our appreciation to those responsible for the present interesting and valuable program;

Second—That the custom be continued of holding an annual Date Institute under the direction of the Coachella Valley Farm Center and of publishing, at cost, its proceedings in standardized pamphlet form;

Third—That to facilitate prompt and accurate publication of future program papers, all such papers should be in the hands of the directing committee of the Institute at least one week prior to the Institute date;

Fourth—That to maintain or raise the standard of future programs, all growers and other interested persons are invited to make suggestions as to subjects for discussion, to the Date Committee of the Coachella Valley Farm Center;

Fifth—That the proper officers of the Date Committee be, and they are hereby directed to express the appreciation of the Institute for past assistance in meeting the problems of this growing industry, to cooperating Federal and State Departments;

Sixth—That whereas many problems confronting the date growers in the Coachella and Imperial Valleys require careful investigating with adequate laboratory facilities, and

Whereas, the State Citrus Experiment Station at Riverside is near at hand and equipped to handle much of this work,

That the Fourth Annual Convention of the Date Institute earnestly urge the State University to provide the necessary appropriations and facilities for undertaking such scientific work, especially soil management with particular emphasis on fertilization and irrigation.