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Twenty-Second Annual

Date Growers' Institute

APRIL 28, 1945

HELD IN

COACHELLA VALLEY

CALIFORNIA

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The Date Institute

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DETERMINATION OF MOISTURE IN DATES BY MEANS OF A REFRACTOMETER

By G. Leonard Rygg, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture

Careful control of the moisture content of dates is of increasing importance in the preparation of this fruit for the market. Under conditions that permit prompt sale to the consumer the need for control of the moisture content is not always obvious, since spoilage is not likely to occur in serious quantities. On the other hand, when dates must be held in storage or on the retailer's stand for appreciable periods of time, spoilage is likely to assume serious proportions if proper control measures are not taken, either by adjusting the moisture content to a safe level or by other means.

The range of moisture contents at which dates can safely be marketed is limited at the lower level by texture and appearance, whereas it is limited at the upper level by the tendency to spoil or deteriorate from molding, fermentation, excessive darkening, or loss of flavor. Control of moisture content to values below 22 per cent or above 33 per cent is also one method of delaying the appearance of sugar spotting in varieties that are subject to this trouble (3).

Before adequate and satisfactory control of moisture can be achieved at the packing house, it is necessary to have access to a method for its determination that is reasonably accurate and so rapid that the results can be secured without delay. The use of a refractometer provides such a method. When this instrument is used a moisture determination can be had in less than two minutes after the sample has been prepared, and when the proper varietal correction has been made, the value will be within one-half percent of the vacuum oven value.

The suggestion was first made in 1938 that a refractometer could be used for determining the moisture content of dates (2). At that time the results of the refractometer method were compared to those obtained by the method of Bidwell and Sterling (1) which consists in boiling the material in toluene and catching and measuring the water that is distilled off. Reasonably comparable results were obtained by these two methods. More recently a vacuum oven has been used in the standard determination of moisture, and it has become evident that the moisture content as obtained by the Bidwell and Sterling method was usually too high as a result of boiling too long. It was clear, therefore, that the moisture content as indicated by the refractometer was also too high. Consequently, it was found necessary to develop corrections to be applied to the moisture content determinations found with the refractometer before accurate results could be obtained. The purpose of this paper is to give some such corrections.

Materials and Methods

A relatively recent model refractometer of the Abbe type was used in this work. This model has a window that permits the use of light reflected from the surface of the material as well as light transmitted through it. This feature is highly desirable for the determination of moisture in dates, especially those that are fairly dry. Within the last year an instrument manufacturing company in this country has announced a small hand refractometer that is more convenient and less expensive than the larger table model, and that is equally suited to the determination of moisture in dates. The hand instrument is read directly in percent solids (as sugar), rather than in refractive index, and it has a built-in thermometer that gives the correction for temperature rather than the actual temperature in degrees.

Since the hand refractometer is more likely to be used in the packing house than the larger table model, the procedure in using the smaller instrument is given here. The steps are as follows:

1. Prepare the date material for testing by passing it through a small food chopper equipped with a fine cutter such as a nut butter cutter and mixing the paste that is produced.
2. Apply a uniformly thick smear on the inner face of the cover of the refractometer and press the cover firmly against the glass prism.
3. Read the temperature correction on the built-in thermometer.
4. Read the percent solids in the sample by looking through the exit pupil of the instrument into somewhat diffused light. The line of demarkation between the light and the dark portion of the field indicates the percent solids as shown on the scale.
5. Apply the correction noted in (3) to the reading obtained in (4).
6. Subtract the value obtained in (5) from 100 to get the percent moisture.
7. Apply the variety correction given below; the result is the percent moisture in the sample.

The date smear is applied to the surface opposite the polished glass rather than directly on this glass to avoid scratching the highly polished surface. This glass is relatively

soft, and the operator can not be cautioned too strongly against scratching it. Grit should be removed from the surface of the dates before the sample is prepared, and the operator should avoid allowing the finger nails to touch the glass. The instrument may be cleaned by holding the prism end under a water tap and carefully removing the date material. The main part of the instrument must not be placed in water, as moisture must not be permitted to enter the interior. Hot water must not be used, but warm water is permissible if the instrument will be afforded an opportunity to cool before the next determination is made. Dry the instrument with a clean, soft, absorbent cloth. General operating instructions are provided with each instrument by the manufacturer.

The temperature correction is preferably read before the percent solids in the sample, since the operator's hand is likely to be held near the bulb of the thermometer and will quickly raise the temperature of the thermometer while the percent solids is being read. The correction for temperature is likely to be too high if the procedure is reversed.

In establishing the correction factors that are given below, the true moisture content of each lot was taken to be that obtained by drying small lots (6 to 8 grams) in vacuum at 149°F. (65°C.) for two days. Drying was hastened by spreading the date paste in a thin layer on the bottom and sides of aluminum dishes.

Twenty-five lots were used for each variety. The moisture content of the dates used in this work covered a range from 15.5 to 43.0 percent.

RESULTS

Correction factors for several varieties are given in table 1.

Table 1. Correction factors to be applied to values for moisture content of dates as determined with the refractometer.

Variety	Correction
Deglet Noor	—1.4
Dayri	—1.4
Zahidi	—1.3
Khadrawy	—1.2
Halawy	—1.2
Saidy	—1.1
Medjhool	—1.0
Maktoom	—0.7
Barhee	—0.3

Factors That Affect the Size of the Correction

The possible influence of three factors upon the size of the correction has been checked.

1. **Variety.** While the correction for most of the varieties given do not differ greatly, that for the Barhee is much less than most of the others. The Maktoom is intermediate. The reason for this has not been ascertained, but it may be related to the fact that the proportion of insoluble solids in total solids for the Barhee is lower than in the case of the other varieties. For example, the insoluble solids (in 80 per cent alcohol) in the Barhee constitute about 9 percent of the total solids, whereas the corresponding value in the Deglet Noor is about 12 percent. It is, of course, partly the presence of the insoluble solids that makes it necessary to apply a correction to the moisture content as found by the refractometer, since the refractometer gives a reading only of the amount of solids (as sugar) dissolved in the water contained in the fruit.

2. **Moisture content.** It might be supposed that a correction appropriate for dates with a high moisture content will not be suitable for dates of the same variety with a low moisture content. This has not proved to be true. Dates having a moisture range from 15.5 to 43 percent were used in preparing the correction factors reported in this paper, and there was no evidence that different corrections were needed at high and at low moisture levels. In the Deglet Noor there was a positive correlation of 0.33 between size of correction and percentage of moisture, and in the Dayri there was a positive correlation of 0.28. Neither of these is statistically significant. The correlation in other varieties were even lower.

3. **Color.** There were indications that within a given variety the correction for very dark fruit is lower than that for fruit with normal color. However, these results were not consistent. For example, in the Barhee there was no noticeable effect of color upon the size of the correction. On the other hand, a correction of —1.0 was indicated for dark Deglet Noor fruit as compared with —1.4 for normal fruit, and a correction of —0.8 for dark Saidy as compared with —1.1 for normal fruit. The correction for very dark and badly fermented Saidy was only —0.2.

The lowering of the correction figure required for dark fruit as compared with lighter colored fruit of the same variety is probably not directly related to the change in color. If this were true, similar results should have been observed with the Barhee. It is more likely that the effect on the correction factor is related to other changes brought about by the same conditions as those that were conducive to darkening. One of these changes is the conversion of some of the insoluble solids into soluble solids, such as the conversion of protopectin into soluble pectin.

SUMMARY

Reasonably accurate and very rapid determinations of moisture in dates can be made by using a refractometer. Correction factors have been developed for several varieties. After appropriate corrections have been made, moisture determinations made by means of a refractometer agree with vacuum oven results within 0.5 percentage units, and usually within 0.3. The simplicity and the rapidity of the method are factors that favor the use of the refractometer as an aid in guiding packing house operations.

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OMPHALIA ROOT ROT QUARANTINE AND GRADE INSPECTION OF DATES

By W. H. Wright, Agricultural Commissioner, Riverside County

Date decline was first recognized in 1921 near Indio, and was found in four plantings of imported Deglet Noor palms by 1927. The situation with respect to this disease has been so aptly stated by Dr. Donald E. Bliss in his publication on Omphalia Root Rot of the Date Palm I wish to quote him, "In considering the problem of omphalia root rot, one should think not only of the present situation but also of the influence it may exert on the date industry of the future. If it had been recognized at first as a pathogenic root rot and a potential threat to the date industry, complete eradication might have been possible. If complete eradication is not practicable, it is highly desirable to control and to limit the spread of omphalia root rot wherever possible."

For a good many years well informed growers have taken steps to control or prevent the spread of omphalia root rot wherever possible. Nearly six years ago a group of representative date growers met with the County Agricultural Commissioner to discuss the feasibility of this office certifying date offshoots as free from omphalia root rot. Due to the fact that date offshoots may be infected with no positive visible evidence present and due to the extensive sampling and laboratory tests which would be required to determine the presence or absence of disease, it was considered impractical for the Commissioner to issue such certificates.

During this period there was practically no extensive new acreage being planted and thus only a limited demand for offshoots. Therefore it was agreed to request Dr. Bliss to inform the Agricultural Commissioner of gardens with known omphalia root rot infected palms and of newly found infection when determined. This information was then provided for the files of Harry Bloom, the District Agricultural Inspector representing the Commissioner's office. The purpose of this program was to have information available on locations of known infected palms for the benefit of growers who wished to obtain such information. With this knowledge they were in better position to obtain offshoots from disease free portions of gardens, or from gardens in which the disease was not known to occur. Many grower calls were received for this information.

Increased prices for dates the last two years have stimulated the demand for offshoots for new plantings. Also with many new owners coming into the Valley who are not familiar with this disease, established growers interested in the future of the date industry believe further steps to control the spread of the disease should be considered. At a meeting of representative growers and Dr. Bliss, called together on the evening of January 9, 1945, by H. B. Richardson, Assistant County Agent, the County Agricultural Commissioner outlined a plan for serving, under authority of Section 128, California Agricultural Code, a "Hold Notice" on owners of date gardens having known infected palms. This "Hold Notice" to require the **destruction** of offshoots on omphalia root rot diseased palms and of all offshoots on palms within 70 feet of the diseased palm. This latter requirement is necessary as a safety factor since it is known that interlacing roots from affected palms may have infected apparently healthy adjoining palms. If the offshoots are not voluntarily removed and destroyed it will be necessary for the Agricultural Commissioner to take legal pest abatement action under authority of the Agricultural Code. This program received the approval of those growers present, with a further suggestion that a letter outlining the proposed plan be sent to all owners of date gardens. Such a letter was sent by the Agricultural Commissioner requesting suggestions or criticisms. While only a few replies were received, those few strongly endorsed such a program.

"Hold Notices" have been served on owners of 29 gardens. In only three cases, where extensive distribution of the disease occurs, has it been necessary to place a quarantine on all offshoots in the planting. However as it had been several years in some gardens since the last samples had been taken by Dr. Bliss for diagnosis, and there appeared to be an extension of the disease, 61 samples of roots were taken by Fred Platt, Deputy Agricultural Commissioner, and Harry Bloom for laboratory determination by Dr. Bliss. Of these 34 showed negative and 27 showed positive or the presence of omphalia root rot. This information has enabled us to quarantine offshoots on all known infected palms.

The results from these samples serve to further emphasize the necessity for having a competent plant pathologist employed by the State Department of Agriculture located in the Coachella Valley to carry on a continuous survey and investigation to determine the presence of omphalia root rot. Only after all infected palms are located will it be possible to prevent the distribution of offshoots from diseased palms.

As a necessary part of this program the growers at the meeting January 9 took steps to initiate legislation appropriating funds to the Bureau of Plant Pathology, State Department of Agriculture, to employ a plant pathologist, provide a laboratory and necessary equipment. Since omphalia root rot could be a limiting factor in future date production in this county, I trust this legislation will receive favorable consideration by the Legislature.

While some growers will suffer a monetary loss, I wish to commend them for supporting this program and for their cooperation with this office. Omphalia root rot is more widespread than was believed before this program was undertaken, and it is most important to the future of the date industry that every practical means possible be taken to prevent further spread.

DATE STANDARDIZATION INSPECTION

One of the duties of the County Agricultural Commissioner's office is enforcement of the standardization chapter of the California Agricultural Code. This chapter contains general sections pertaining to all fruits, nuts and vegetables, as well as grade and packing standards for thirty-two commodities. These grade standards were established by the legislature at the insistence of

growers of these products. In order to obtain uniformity of enforcement, particularly between counties, this work is under the supervision of the Director of the State Department of Agriculture.

The standard for dates, Section 798 of the Agricultural Code, states in part as follows, "Dates and date by-products shall be free from mold, decay, worms, insect injury, insect debris or frass, fermentation, sourness and bird pecks causing serious injury to the flesh".

"Not more than 5 percent, by count, or in the case of dates packed in blocks, by weight, of the dates in any one container or bulk lot may be below these requirements but not to exceed one-half of this tolerance shall be allowed for any one cause, except that no part of this tolerance shall be allowed for the presence of live insects." There is also a paragraph on marking requirements which requires that packages be marked with the net weight, packages and bulk dates, with the name of state or foreign country where grown, and that all containers of dates which have been subjected to a hot water or steam process treatment be marked with the words "hydrated dates," or "steamed dates."

"Dates which are being delivered to any person in the state for purposes of grading, packing or reconditioning, or which are being held in storage for such purposes, are exempt from the provisions of this section."

This is a minimum standard for dates and does not prevent any person, firm or association from packing a higher standard of quality. A higher quality standard can be the policy of an individual or firm on a voluntary basis, or such standards of grade as desired can be written into a Marketing Order, this latter method having been used in the Marketing Order for Dates during the seasons this Order was in effect.

In those cases where an industry has a Marketing Order, some confusion and possibly over-lapping of inspection may result with two or three agencies making inspections. This was true with the 1943 crop of dates, with the Shipping Point Inspection Service inspecting whole dates under the standards of the Marketing Order. If the dates in the lot failed to meet the standards of the Marketing Order and the lot was below the minimum state grade, the lot was reported to the county or state inspectors to follow through on reconditioning. The S. P. I. inspectors make inspections for grade only as enforcement of minimum grades is a function and duty of standardization inspectors of the State Department of Agriculture and County Agricultural Commissioner's office.

Climatic conditions during 1943 apparently were favorable for a heavy infestation of worms. This condition created a demand for more inspection than normal. Therefore, the Agricultural Commissioner requested help from the State Department of Agriculture in making inspections until the Commissioner could locate competent personnel to employ. The Department complied with this request, but with three agencies making inspections the situation was not entirely satisfactory. However after employment of two inspectors by the county working together with S. P. I. inspectors practically all of the overlapping of inspection was eliminated.

During the 1944 harvest season the Agricultural Commissioner was requested by the date packers to issue upon request certificates of inspection on lots of packed dates ready for shipment. In order to provide this service and absorb some of the cost the Board of Supervisors, under authority Section 783 California Agricultural Code, established a schedule of fees for certificates. As of April 21, 1945, certificates have been issued on 252,836 packages of dates, 457 certificates written, and $1,255.00 collected by Riverside County. Since requests are still received for certificates we believe this service has been of assistance to the date industry in maintaining a good quality pack.

Without a Marketing Agreement and Order in effect for the 1944-45 crop, inspection has been conducted in the Valley by inspectors from the Agricultural Commissioner's office. Due to late maturity this season and failure in some instances to take this into consideration in curing we have had some trouble with mold, but very little difficulty with worms or frass. Probably one of our most difficult problems has been the handling of dates for by-products. I would like to emphasize that the grade standard for dates makes no distinction in the minimum grade for whole dates and for those to be used in by-products. In referring to Section 784 of the Agricultural Code, it states, "It is unlawful to **prepare**, pack, place, deliver for shipment, deliver for sale, load, ship, transport, cause to be transported or sell any fruits, nuts, or vegetables in bulk or in any container or sub-container unless such fruits, nuts and vegetables, and their containers, conform to the provisions of this chapter." The Attorney General has ruled that **washing, pitting,** and **macerating** dates is to **prepare** before further use, therefore as stated in Section 798, and as was evidently the intent of the industry, all whole dates and dates used in by-products must meet the minimum standards. Thus the law requires that dates for by-products, even though they are out of an orchard run lot from the packers own garden or from a lot purchased as orchard run for first grading and have not been sold or offered for sale must be within the tolerance of not more than 2½ percent of any one defect and not more than 5 percent total defects. We believe a clear understanding of the above provisions of the Agricultural Code by packers who also make date by-products will eliminate some of their difficulty.

As the volume of date production in the Coachella Valley has increased and some practical problems in grading have become apparent date growers have asked the legislature to make certain changes in the date standards section of the California Agricultural Code. The tolerance of not more than 2½ percent for one defect or not more than a total of 5 percent of all defects is retained, however I believe the most important change is the one permitting insect or worm debris and frass on 25 percent of the pit cavity before it is counted as a defect.

The growers believe this change will eliminate the necessity for regrading lots of dates with a small amount of worm debris or frass, prevent the loss of good dates thrown out in the process of reconditioning, and still not materially lower the quality of dates marketed.

In addition to the proposed change in Section 798 of the Agricultural Code, mentioned above, now before the Legislature in Senate Bill 843 I suggest that immediate action be taken to notify Senator Dilworth to include the following words in this Section between the words date by-products, "intended for use in," or

the Section would read: "Dates and dates intended for use in by-products shall be free," from the defects mentioned within the tolerance allowed, if this is the intent of the industry. This change would clarify the Section and conform with the requirements of Section 784 of the Code.

After the dates are macerated and used in various products it is obvious that inspection is no longer a standardization problem, but one for the Bureau of Food and Drug Inspection under the State Department of Public Health.

The date growers of Coachella Valley have established their reputation in the markets for a high quality product, and even during the present situation of keen demand and little or no competition from foreign dates, they should zealously guard that reputation so that they will be in a stronger position to meet the competition which will surely return.

THE DATE SITUATION AND OUTLOOK*

By H. R. Wellman, Director of the Giannini Foundation of Agricultural Economics, University of California

Twelve years ago last month I attended my first meeting with date growers. At that time you had just completed a most disastrous season. The average farm price of dates in 1932 as reported by the California Cooperative Crop Reporting Service was only $40 a ton, and total returns to growers amounted to only $86,000. You have come a long way in the past twelve years. Preliminary estimates with respect to the 1944 date season indicate an average price to growers for naked fruit at the first delivery point of $500 a ton, and total returns to growers of 5.5 million dollars. Thus, there has been more than a twelve-fold increase in price per ton, and a sixty-five fold increase in the gross value of the crop.

I do not assume that my visit here 12 years ago is in any way responsible for the subsequent increase in prices and returns. If I claimed credit for the increase, I would also have to take the blame for the decrease which will almost certainly follow my present visit. Just when this decrease will occur and how much it will be, I do not know. I am fairly confident, however, that prices and returns on dates will not be maintained indefinitely at the high levels of 1943 and 1944. I shall have more to say on this particular point later on.

First, however, I would like to review with you the basic causes of the very large increases in the prices and returns on dates which have occurred during the past few years. You are, of course, familiar with the facts as to the prices received by growers and the quantities marketed, but perhaps a few figures would not be amiss simply as a reminder.

During the five years 1936-1940 the farm price of California dates averaged $120 a ton; during the two years 1943-1944 the average farm price was $460 a ton. Between these same periods the harvested production of California dates rose from an average of 4,000 tons to an average of over 10,500 tons. These are astounding increases. Within this short span of time, from 1936-1940 to 1943-1944, the demand for California dates was expanded sufficiently to permit an increase of 160 per cent in the quantity marketed and an increase of 285 per cent in the farm price.

This phenomenal increase in the demand for California dates was chiefly the result of two factors, both of which are directly related to the war. One of these factors is the enormous increase in the incomes of consumers in this country; the other is the virtual stoppage of imports of foreign dates.

Aggregate income payments to individuals in this country during the two years 1943-1944 averaged 150 billion dollars annually, over twice as large as the 1936-1940 average of 71 billion dollars. True, personal taxes are much higher now than before the war, and consequently not all of the increase in income payments has been available to consumers for purchase of goods and services. But even after deducting personal taxes — federal, state, and local—the disposable income of individuals nearly doubled.

Also, it is of considerable importance from the standpoint of the demand for agricultural products that the increase in disposable income has been heavily concentrated in the lower-income brackets. Many thousands of working families in this country had twice and even three times as much money to spend in 1944 as in 1940, owing to higher hourly wage rates, longer work-week with overtime pay for more than 40 hours, and more members of the family working.

The second major factor which contributed to the great wartime expansion in demand for California dates was the curtailment in the imports of foreign dates. During the five years 1936-1940 importations of foreign dates into the United States averaged 24,200 tons annually, six times as large as California's production during the same period. With the interruptions to normal shipping caused by the war, importations of dates fell drastically and by 1943 had virtually disappeared. During the past two seasons California date growers have had the domestic market virtually to themselves. And what a good market it has been!

It is well, I think, to recognize that date growers have on the whole fared better during the past two years than have producers of most other agricultural products, at least as compared with the prewar years. One measure, although by no means a perfect one, of the relative gains among the different agricultural products is cash income for farm marketings. These income figures are gross incomes rather than net incomes. They do not take into account changes in costs of production, and it is true that costs of production have increased more in the case of some agricultural commodities than in the case of others. Nevertheless relative changes in gross income provide at least a rough picture of the comparative gains of the different agricultural products.

The figures which I shall cite represent the percentage increases in total income from farm marketings in the United States between

* The statistics on dates cited in this paper were compiled by my colleague, Dr. S. W. Shear.

the two periods 1936-1940 and 1943-1944: all agricultural products, 143; all crops, 139; all livestock, 146; all vegetables, 157; all fruits, 190; prunes, 201; avocados, 316; figs, 397; grapes including raisins, 407; dates, 948. I know of no other agricultural commodity for which the relative increase in United States gross farm income during the war has been as large as in the case of dates.

The very high wartime returns which have been experienced in agriculture generally, and particularly in some products are not without their dangers, as you well know. One of those dangers is inflation of land values. I do not know what the situation is with respect to the increase in the sales price of date gardens. But I do know that over the United States generally, and on the Pacific Coast, land values have been increasing rapidly, at least as rapidly as during the first World War.

In Imperial County the sales price per acre of irrigated land has doubled within the past two years. About one-half of the sales were for cash. On the other half, the down payment averaged 32 per cent of the purchase price. A decrease in the price of this land to the level which prevailed just two years earlier would mean that the average purchaser who bought on mortgage would lose all of his down payment and in addition would still owe one-fourth more for the land than it would bring in the market. It may be quite difficult for these buyers to pay for the land out of current earnings after wartime prices of agricultural products return to more normal levels.

One of the most unfortunate legacies which American agriculture inherited from World War I was a huge mortgage debt, the aftermath of which caused much of the acute distress in farm areas and jeopardized the wellbeing of numerous farm families. Between 1914 and 1920 total farm mortgage debt in the United States rose from 4.7 billion dollars to 8.4 billion dollars, an increase of 80 per cent. In addition there was a marked rise in short-term debt, much of which had to be refinanced on a longer-term basis. Hence, total mortgage debt did not reach its peak of 10.8 billion dollars until 1923, more than two years after the abrupt decline in farm prices. Within the brief span of 12 months—between June 1920 and June 1921—farm prices in the United States dropped 50 per cent on the average. Prices of many farm products fell 70 per cent and more. At that time farmers learned by bitter experience a very simple but nevertheless basic fact; namely, that it takes an enormous quantity of low priced products to pay off debt contracted at high prices.

Unlike the last war, total farm mortgage debt in the United States during this war has been decreasing not increasing, and this is most encouraging. We should not, however, be complacent about the matter. The situation could easily change. It is well to remember that the greatest speculation in land values and the largest increase in farm mortgage debt occurred after the signing of the Armistice in 1918, not before. There is still time for the development of a highly dangerous situation in the current overall farm debt picture. Also, one should recognize that a continued reduction in total United States farm mortgage debt will not in itself help those individuals who go heavily into debt to purchase land at inflated values.

It seems clear that prices of many agricultural products will have to come down from their present high wartime levels, and I would certainly include dates in the list of such products. Even though the nation is successful in maintaining substantially full employment and large annual earnings of workers after the war, present prices of quite a number of agricultural products, including dates, would still be too high from the standpoint of balancing production and consumption. By this statement I do not mean to imply that returns to growers would necessarily fall to distressing low levels. On the contrary, maintenance of high-level production and employment in industry and trade in this country after the war would go far toward assuring good markets for our agricultural products and particularly for the specialty commodities grown in California.

The importance to farm people of high-level production and employment in industry and trade can hardly be over-emphasized. In such high-level production and employment lies the basic solution of the farm income problem. Date growers certainly have as large a stake in the attainment of full production and employment throughout all segments of our economy as any other group of farmers in California.

Regardless of economic conditions in the United States, importations of foreign dates will very likely be resumed as soon as the war is over and thereby remove one of the causes of the present high price of California dates. So far as I can determine from the available information, the productive capacity of date gardens in Iraq and Iran, the principal date exporting countries of the world, has not been reduced significantly. Those countries will again be seeking outlets as soon as normal shipping becomes possible. The United States has long been one of their important markets, and this country will probably be more prosperous after the war than most other contries.

Importations of foreign dates in substantial volume such as prevailed prior to the war will, of course, tend to restrict the market for California dates. Competition from foreign dates will not, however, be too serious for domestic producers, if the national income can be maintained at a high level. Whether that will be done, however, remains to be seen. With a large national income, the market for dates in this country will be broad enough to absorb at reasonably good prices our entire domestic production and at the same time take an even larger volume of foreign dates than were imported before the war.

Production of dates in California has apparently reached its peak for the time being. On the basis of the age distribution of present plantings and the average yield per acre by age of palms, my colleague, Dr. S. W. Shear, has estimated that the trend of production during the next several years will be around 11,000 tons. Production in 1943 amounted to 10,540 tons, and the preliminary estimate for 1944 is 11,000 tons.

The bearing acreage of dates in California has remained virtually stationary at around 3,000 acres since 1939. Production during the past five years, however, continued to climb at about the same rate as in previous years owing to the increased bearing capacity of the maturing young acreage and to the better care given the gardens. Most of the gardens have now reached substantially full-bearing age. Consequently, further increases in total production from the present acreage will probably be slight.

New plantings of dates during the seven years prior to 1943 were very small, amounting on the average to only 57 acres a year. This rate of planting was hardly more than sufficient to offset the removal of old palms. Official data on plantings in 1943 and 1944 are not yet available. I understand, however, that the rate of planting was stepped up appreciably, particularly in 1944.

There is certainly the possibility, if not the probability, that the very large returns from dates of the past several years will generate over-enthusiasm regarding future prospects and lead to unwise plantings. By the time plantings made now come into production, prices and returns on dates are very likely to be considerably lower than at present. This strong probability, or I might even say this virtual certainty, should be taken into account by all those who are thinking of large additional plantings.

Some additional plantings of dates are, I think, warranted. Annual plantings during the next few years might even be twice as large as the average of 1934-1942, but not four or five times as large.

The date industry still has a good many improvements in marketing to make before a profitable outlet can be developed for a tonnage much larger than it is now producing even under favorable postwar conditions. That the industry is capable of making further substantial progress in marketing I have no doubt. You have already demonstrated real ability along these lines. But it must be recognized that progress in marketing is inevitably slow, and that much toil and sweat are required for significant achievements.

For their own sake, date growers should work together even more closely in the future than they have in the past. Too often, temporary periods of prosperity weaken rather than strengthen cooperative effort. When returns are high more growers are inclined to go their individual ways in the matter of marketing. So long as a seller's market exists as is the case with dates as well as many other products at the present time, there is not in fact any great immediate need for cooperation among producers. But growers cannot expect to have an efficient organization to serve them during normal or bad times, if they forsake it during excellent times. That less favorable times than those now prevailing will come, I have no doubt.

In closing may I summarize my remarks under six points:

1. The war has brought extraordinarily large returns to farmers generally, and particularly to date growers. No other group of agricultural producers has experienced as large an increase in total gross returns during the past two seasons over prewar years as date growers.

2. In addition to the great rise in consumers' incomes which has affected favorably returns from all agricultural products, two other factors have contributed materially to the increase in returns from dates; namely, the virtual stoppage of imports of foreign dates, and the absence of price ceilings on fresh dates.

3. Inflation in farm land values is again occurring comparable to that which prevailed during and immediately following World War I. Although farm mortgage indebtedness for the country as a whole is not yet on the increase, many individual purchasers of land are going heavily into debt. They may find themselves in grave difficulties when wartime demands for and prices of agricultural products subside.

4. In the absence of a prohibitive tariff, importations of foreign dates will be resumed as soon as normal shipping again becomes available. These importations will compete to some extent with domestic dates. The competition, however, will not be too serious, provided consumers' incomes in this country do not shrink drastically.

5. The most urgent problem confronting this country in the postwar years is that of maintaining continuously high-level production and employment in industry and trade. Large annual incomes of workers based upon such employment would go far toward assuring a good market for agricultural products and particularly for our California specialty products, including dates.

6. And lastly, date growers themselves can do a good deal to help maintain a prosperous industry in the postwar period. Individually, they can give constant attention to ways of reducing costs of production and of improving quality, and they can refrain from over-planting. Through cooperation they can increase efficiency in marketing and expand consumption.

JAMES ARKELL

1880 - 1945

It seems appropriate on this occasion to speak a word of appreciation concerning the life of James Arkell, a prominent date grower of the Coachella Valley, who died April 6, 1945, of coronary thrombosis.

Mr. Arkell was born October 23, 1880, in Canajoharie, New York. He was educated in public and private schools and at Columbia University, where he studied mining engineering. In 1906 he married Claire Mathez, and shortly afterward, the young couple went to the state of Zacatecas, Mexico, where for 15 years they were interested in mining operations. The Arkells left Mexico at the time of the Mexican revolution and went to Cuba, where Mr. Arkell took charge of a sugar cane plantation.

Mr. Arkell became interested in the cultivation of dates in 1930 when he received from his father, the late W. J. Arkell, a part interest in 160 acres of land in the Indian Wells district of Indio. In 1931, James Arkell came to California from Cuba and formed a corporation with L. Eugene Carpenter and Nellie Carpenter Foltz, who, with W. J. Arkell, had been the original owners. This corporation was soon dissolved and the property was divided among the three members according to stock interest of each. The Carpenter and Foltz interests were deeded 9½ acres of date orchard and 30½ acres of undeveloped land, while the remainder of the quarter section became the property of James Arkell. His orchard, originating from a portion of the initial 1929 planting of Deglet Noor palms from Yuma, Arizona, has since been enlarged to about 50 acres. It now contains some of the highest-yielding palms on record, and is one of the show places of the Coachella Valley.

Because of his enthusiastic support of the cooperative marketing movement and his efforts to improve date production in the orchard, Mr. Arkell made a substantial contribution to the local date industry. He was interested in raising the market standards of California dates so that they would not compete directly with imported dates, and he was at one time treasurer and a director of the California Date Growers' Association. Though belonging to a strong cooperative organization, he did not favor the enrollment of all date growers in one group. He believed that competition from a small group of independent growers was beneficial in its effect on the cooperative organization.

JAMES ARKELL

In 1935 Mr. Arkell asked Dr. L. D. Batchelor, Director of the University of California Citrus Experiment Station, for assistance in organizing and conducting a fertilizer experiment in his orchard. Accordingly, a cooperative project was initiated, which included Mr. Arkell, the California Date Growers' Association, and the University of California. Though interrupted by the war, this project has contributed significantly toward increasing the acre-yields of dates in this region. In the experimental orchard, the annual fruit production increased from about 160 pounds per palm, in 19 to about 350 pounds per palm, in 1942. This increase was due in part to the maturity of the palms, to the application of large amounts of irrigation water and fertilizer, and to the retention of all green leaves on the palms. Mr. Arkell not only gave time and financial support to this project, but also wanted the entire date industry to profit by his experience. Three preliminary reports have been published*, and a more comprehensive report will follow.

Mr. Arkell was a generous, public-spirited man who exerted a stimulating influence on the California date industry. He was a genial host and a splendid cooperator. He is survived by his widow, Mrs. Claire Arkell of Indio, a sister, Mrs. A. L. D. Warner of Beverly Hills, and a granddaughter, Claire Jem Arkell of Riverside.

DONALD E. BLISS,
University of California Citrus Experiment Station,
Riverside, California.

* Mathez, Forrest. 1941. Bearing capacity of Deglet Noors in terms of fruits per leaf. Date Growers' Inst. Ann. Rept. 18:24-26.

Sinclair, Walton B., E. T. Bartholomew, and Donald E. Bliss. 1941. Composition of dates as affected by soil fertilizer treatment. Date Growers' Inst. Ann. Rept. 18:11-16.

Mathez, Forrest, and Donald E. Bliss. 1942. The relation of leaf area to alternate bearing in the Deglet Noor palm. Date Growers' Inst. Ann. Rept. 19:3-7.

IRRIGATION EXPERIMENTS WITH DEGLET NOOR DATES

By Walter Reuther and C. L. Crawford*, senior horticulturalist and senior scientific aide, respectively, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, Indio, California

One of the major factors limiting igor, yield, and fruit quality of the ate palm in the Southwest, is vailability of soil moisture. In our pinion, it would be difficult to ver-emphasize the importance of naintaining adequate amounts of oisture in the soil at all times in rder to obtain vigorous palms producing high yields of good quality uit. With the favorable soil, ferlity, and cultural conditions found n most plantings, full-bearing Degt Noor palms receiving adequate oisture throughout the season will roduce 25 to 30 large leaves each ear, grow 2 to 3½ feet in height, roduce 15 to 22 inflorescences, and aintain a crown of 130 or more reen leaves. Palms growing under onditions of chronic moisture defiency produce fewer, smaller leaves er year, grow less in height, prouce fewer and smaller inflorescences, and maintain fewer leaves in reen condition. As a natural conequence, they also produce smaller ields of fruit, which ripens early nd is of low quality. Nearly all rowers recognize the general appearance of low vigor induced by evere and chronic moisture stress. owever, the effect of a moderate nd transitory moisture stress is ather difficult to see by a casual spection of the palm, yet such deciency may profoundly affect ield and quality of fruit, particurly when it occurs during the critial summer months when the fruits re developing and beginning to pen. The primary purpose of this aper is to report data which indiate the effect on palm growth, ield, and fruit quality of a moderte deficiency of soil moisture beinning July 15, 1944, and continug until all fruit was harvested.

Plan of Experiment

A block of young bearing Deglet oor palms located at the U. S. ate Garden, ranging in age from 7 to 9 years, was used for this experiment. The surface foot of soil in the plot area is a fine sand which takes water rapidly. Beneath this sandy surface soil there are numerous silt loam to silty clay loam layers separated by layers of fine sand. The silty layers aggregate 3 to 6 feet in thickness in the first 8 feet of soil. The block was divided into ten plots, 3 rows wide and 6 to 7 palms long. Detailed growth, yield, and grade data were obtained from the center row of palms in each plot; only summarized grade data were obtained from the two outer "border" rows. Five of these plots, called wet plots, received heavy irrigation throughout the season. The remaining five, called dry plots, were irrigated very sparingly during the period June through October, but heavily during the rest of the 1944 season. During this period of reduced irrigation of the dry plots only half of each middle was irrigated each time, and the other half at the next successive application of water. The details of the differential irrigation treatments are summarized in table 1.

Experimental Results

The effect of reducing irrigation in summer and fall on the rate of growth of the palms as measured by the rate of leaf elongation‡ is indicated in figure 1. It will be noted that the palms in the wet plots grew at a rate between 4.25 and 4.75 cm. (1 2/3 to 1 7/8 inches) per day during this period, while the rate of growth in the dry plots was reduced to between 3.5 and 4.0 cm. (1 1/3 to 1 1/2 inches) per day. This represents a reduction of only about 20 percent in rate of growth, yet it quite markedly influenced the crop of fruit produced.

The curves for weight of fruit presented in figure 1 were obtained by securing samples from representative trees in wet and dry plots. Note that the reduction in rate of growth of palms was associated with a reduction in rate of growth of fruit also. The soil moisture curves at the bottom of the figure indicate that moisture in the dry plots at a depth of 30 inches was maintained at less than 40 percent of total storing capacity during the period of differential treatment; while at the same depth in wet plots during this period moisture was maintained between 75 and 100 percent of total capacity§. In attempting to relate these curves to the others presented it should be borne in mind that there is an inverse relation between moisture tension in the soil (the security with which moisture is held by the soil) and moisture content of soil. Thus, the higher the tension, the less moisture there is in the soil. Note that although normal irrigation of the dry plots was resumed by the middle of October, it was not until the middle of December that the soil at a depth of 30 inches again contained as much available moisture as at the comparable depth in the wet plots; and it was not until February of 1945 (data not shown) that the rate of leaf growth of the palms in the dry plots again equalled that of the wet plots.

The data presented in table 2 are largely self-explanatory. They indicate that withholding moisture during the developing and ripening period markedly reduces the percentage of high grade fruit, as well as reducing total yield about 17½ percent. It is of particular interest to note that reducing irrigation did not reduce loss from drop, but if anything, increased it slightly under the conditions of this experiment. The data presented for the "border wet" and "border dry" treatments were obtained from palms receiving irrigation treatments intermediate between the wet and dry plots. The

* The authors wish to express hanks to the California Date Grows' Association for cooperation in rading lots of dates from our exerimental plots.

‡ For details of this technique see Aldrich et al. Amer. Soc. Hort. Sci. 41:77-84. 1942.

§ The limits indicated in this statement are rough approximations obtained from inspection of unpublished data relating tension to moisture content of soil in this block, and supplementary data on soil samples obtained from this location published by L. A. Richards and L. R. Weaver in Jour. Agr. Res. 69:215-235. 1944.

TABLE 1. TREATMENT OF IRRIGATION PLOTS

Month, 1944	Wet Plots		Dry Plotts	
	No. irrigations	Inches water applied per mo.	No. irrigations	Inches water applied per mo.
January	2	11	2	11
February	1	5½	1	5½
March	3	16½	3	16½
April	2	11	2	11
May	2	11	2	11
June*	3	16½	1	5½
July	3	16½	1	3
August	3	16½	2	6
September	2	11	2	6
October*	3	16½	3	11
November	1	5½	1	5½
December	1	5½	2	11
Total	26	143 or 11.9 ft.	23	103 or 8.6 ft.

* Differential treatments were started June 15, 1944, but no difference in rate of leaf grow developed until about July 15, 1944. Differential treatments were discontinued on October 16, 1944, but rate of leaf growth in dry plants remained below that of wet plots until February, 1945.

border dry palms had access to slightly more moisture than palms in the dry plots, and the border wet palms had access to slightly less water than palms in wet plots. The grade records for these suggest that the border wet palms produced about the same quality of fruit as the wet plots, but that produced by the border dry plots was definitely of poorer quality. Thus, it appears that a moisture stress slightly less drastic than that obtaining in the dry plots would be reflected by a lowering of grade. Note further that the greatest lowering of grade occurred in the first picking (October 16, 1944). Fruit of the second (November 22, 1944) and third (January 15, 1945) pickings in both wet and dry plots was of better quality, and the difference in quality of fruit from wet and dry plots was less pronounced.

The 1944 season was an exceptionally late season with respect to fruit ripening. Had it been more nearly normal, more fruit would have ripened during the hot weather, and probably there would have been an even greater difference in grade than indicated by this season's data.

Note that there is good qualitative agreement between the grade data obtained by the U. S. Date Garden and that obtained by the California Date Growers' Association. However, in some cases, there are quantitative discrepancies between the two gradings. The major reason for this was the fact that somewhat inexperienced fruit graders were used in obtaining our data, and thus some of the grade standards, particularly for the A and C grades, were somewhat in error as compared with those of the California Date Growers' Association.

The 1944 crop of dates from all plots was virtually free from blacknose, but slight to moderate checking was prevalent on many fruits. Careful counts indicated that 51 percent of the fruit from the wet plots and 34 percent from the dry plots showed some degree of checking. However, checking was not severe enough in either treatment to be an appreciable grade-reducing factor.

The data presented in table 3 indicate that the major portion of the reduced yield caused by reducing irrigation was due to reduced size of fruit. As would be expected, the fruit from the dry plots was dehydrated to a greater degree than that from the wet plots in the case of the first picking, but not in the case of the second. Also, the fruit of the second picking from the wet plots showed a gain in dry weight (mostly sugar) over the first picking, but this was not true of fruit from the dry plots. Thus it appears that unripe fruit left after the first picking of the wet plots accumulated more dry matter than comparable fruit in the dry plots. One of the most striking effects of reduced i

Table 2. The Effect of Irrigation Treatment on Yield and Grade of Deglet Noor Dates. 1944-1945 SEASON

Irrigation Treatment‡	Avg. Total Yield lbs./palm	Average Drop lbs./palm	Average Drop¶ Percent	GRADE SUMMARY									
				Graded by U. S. Date Garden					Graded by Cal. Date Growers Ass				
				%A	%B	%C	%D	% Cls	%A	%B	%C	%D	% C
				First Picking					**First Picking**				
Wet Plots	80.5*	8.1	10.1	6.8*	49.7*	39.1*	3.0*	1.4	7.9	60.9	19.3	9.3	2
Dry Plots	116.4*	14.3	12.3	0.7*	25.3*	66.7*	5.8*	1.5	1.6	25.2	48.1	22.6	2
Border Wet	———	———	———	4.8	53.3	34.3	6.0	1.6	15.2	68.0	11.5	3.3	2
Border Dry	———	———	———	2.1	38.3	50.6	8.0	1.0	8.8	44.8	35.0	9.6	1
				All Pickings§					**All Pickings§**				
Wet Plots	249.5*	16.2	6.5	6.8*	65.7*	22.0*	3.6*	1.9	12.5	67.0	10.7	6.5	3
Dry Plots	205.5*	14.8	7.2	1.3*	41.6*	50.2*	5.3*	1.6	1.6	46.9	30.6	18.8	2
Border Wet	———	———	———	9.0	66.7	18.1	4.1	2.1	12.0	72.7	7.6	4.9	2
Border Dry	———	———	———	3.9	48.1	39.7	6.7	1.6	6.9	55.3	25.7	10.0	3

‡ See table 1 for details of irrigation treatment of wet and dry plots. The "border wet" and "border dry" treatments represent intermediate degrees of moisture stress between the wet and dry plots. Border wet palms had approximately ¾ of their root systems in the wet plots, and ¼ in the dry, while the reverse situation obtained for the border dry palms.

¶ Drop of khalal and ripe fruit which fell before or during picking.

§ These grade percentages are weighted means for all pickings.

* All of these are weighted means of grade or yield records obtained from 16 palms graded individually and the difference between wet and dry plots in all categories except culls are statistically significant. No statistical treatment could be given to the other data presented because these represent grades obtained from aliquots of composite samples.

rigation was on rate of ripening. In the first picking, almost twice as much fruit was harvested from the dry plots as from the wet plots.

Reduced irrigation during summer and fall also had an effect on subsequent blooming of the palms. Spathes on palms in the dry plots emerged somewhat later, and averaged about one per palm less in number than on palms in the wet plots. However, even the wet plot palms have an average of about one-third less blooms this year as compared to last year. This seems to be a general condition in many date plantings in this area this season. It is possible that general light bloom of all palms in all plots may have obscured to some extent the effect of withholding water in summer and fall on subsequent blooming.

Because of soil variations, there was considerable variation among individual palms in the rate of leaf-elongation in the irrigation plots, particularly in the dry plots. Each point on the leaf-elongation curve presented in figure 1 represents the mean rate of 10 palms for each treatment and date. When the average rate for each palm during the period July 5 to November 7 was related statistically to the percent of natural (A and B) grades produced by that palm, it was found that there was a very high degree of correlation between these two factors. In other words, these data show quite clearly that the more rapid the growth of the palm, the higher the quality of fruit produced throughout a wide range of palm vigor. Data from two previous seasons relating total terminal growth per season to fruit quality give additional support to this statement. Thus it appears that rapid, vigorous growth of palms is essential to the production of high quality fruit, and that an adequate supply of soil moisture at all times, but particularly during the hottest months, is one of the primary requirements for high palm vigor.

Much emphasis has been given to the importance of heavy irrigation in date culture. A question which naturally arises is, "Can too much water be applied to dates?" Undoubtedly, there are soil conditions in date growing regions such that the application of very large amounts of water would be harmful. In most cases of this kind it is difficult to assay independently the relative damage done by water-logging and by high salt concentration, as these two conditions will usually be associated. In the majority of the deep, well-drained, low-salt soils on which most date plantings are now located, we have never been able to find any evidence of poor drainage conditions by examination of the roots or the soil profile. In 1942 we set up an irrigation experiment in a block of 7-year-old Deglet Noor palms in which very heavy irrigation, a total of 24 acre-feet per year, was compared with a normal irrigation program which approximated closely the treatment given the wet plots in the 1944 experiment (see table 1). There was no apparent deleterious effect of the heavy irrigation treatment on rate of leaf growth, fruit development, fruit quality, or loss from rot and drop. The following year these heavily irrigated palms produced a normal crop of blooms and fruit. The data obtained from this experiment are summarized in table 4. Note that the palms comprising the very heavy irrigation plots were somewhat larger at the outset than those of the normal irrigation plots. Statistical analysis of the data indicated that there was no significant effect of treatment on the factors measured, with the possible exception of yield, and this is attributed to an initial difference in bearing capacity between the two groups of palms. Another factor which should be taken into consideration in evaluating the significance of these data is the plot arrangement of this experiment. The number of bearing palms in this block in 1942 was not sufficient to provide adequate buffer rows of palms between irrigation treatments. There undoubtedly was some lateral movement of water from very heavily irrigated plots to adjacent normally irrigated plots, and thus the normal plots had available somewhat more water, and the very heavily irrigated plots somewhat less, than the amount actually applied to the surface.

Last year we reported an experiment¶ in which we did obtain a response to very heavy application of water as compared with the application of a normal amount of water. In this connection it might be well to emphasize that the palms used for this 1943 experiment were located on a very deep, sandy soil containing no silt layers in the first 9 feet, and were low in vigor. The palms used for the 1942 and the 1944 experiments were growing on soil having a considerable amount of silt in the first 8 feet, and were quite vigorous.

The data summarized in this paper were obtained during two growing seasons on one block of young bearing Deglet Noor palms. Caution should be exercised so that too generalized conclusions are not drawn from limited experimental data of this type. Thus we expect to modify and elaborate principles and conclusions set forth in this paper as we obtain more extensive experimental data and seasonal experience pertaining to date irrigation practices.

Table 3. The Effect of Irrigation Treatment on Size, Moisture Content, and Rate of Ripening of Fruit

Irrigation Treatment	Average size, wt. moisture content: No. of fruits per pound	Fresh‡ weight per fruit, grams	Dry§ weight per fruit, grams	Percentage moisture,§ fresh basis	Percent of total crop in each picking
First Picking					
Wet plots	40	11.23	7.67	26.2	35.2
Dry plots	46½	9.76	6.89	24.7	59.9
Second Picking					
Wet plots	39	11.54	8.21	29.0	40.0
Dry plots	46	9.85	6.55	28.5*	31.2

‡These are the averages of aliquot samples from each of 16 palms in each irrigation treatment, and include seeds.

§ These averages were obtained from the same samples on which fresh weights were determined, but do not include seeds.

* Statistical treatment of the data indicates that all varieties presented for the dry plots except this one are significantly larger or smaller than the corresponding value for the wet plots.

¶ Reuther, W. Annual Report of Date Growers' Institute 21:16-19. 1943.

Discussion and Conclusions

The data presented in this paper indicate that if Deglet Noor fruit from a given palm, group of palms, or an entire block, tend to be of small size, poor quality, and to ripen early, one of the first things that should be examined carefully is the over-all irrigation practice. If possible, changes in method or rate should be made which will result in a greater supply of soil moisture, particularly during the summer and early fall months. Our experiments indicate that it is advantageous to apply sufficient water in the spring months so that there will be a good reserve supply of available water in the deeper layers of the subsoil. The data presented in figure 1, previously discussed, indicate that there was a lag of about 2½ months before the moisture content of the soil at a depth of 30 inches was restored to full capacity after the resumption of a normal irrigation schedule in October. About the same length of time was required to wet up the deeper layers to full capacity. Thus it appears that if a good supply of soil moisture is maintained throughout the principal root zone (usually 7 to 8 feet) during the spring months, the application of 12 to 18 inches of water per month during summer and fall will be adequate to maintain rapid growth of palms and produce good quality fruit. On the other hand, if any considerable depth of soil in the first 7 or 8 feet is allowed to fall very much below full storage capacity during the spring months, then even 12 to 18 inches per month may not be adequate to maintain a satisfactory rate of growth during the summer and fall. In deep sandy soils, the total moisture storage capacity of the first 7 or 8 feet of soil will be considerably less than in heavier soils containing sizeable silt layers in this zone. Sandy soils in the Coachella Valley have capacity to store about 1½ acre-inches of available water per acre-foot of soil, while silty soils have a capacity of about 2½ acre-inches or more. Thus it is apparent that in order to provide as much available water to palms on deep sandy soil as on silty soils, it is necessary to wet the soil to a greater depth so that deeper rooting is encouraged, and probably to irrigate more frequently during the summer months.

It is a common practice for many date growers to irrigate very spar-

Table 4. The Effect of Very Heavy Irrigation on Production and Quality of Deglet Noor Dates

1942 SEASON

Irrigation Treatment	Avg. yield per palm§, pounds	Fruit Quality¶ Avg. percent dry fruit (C & D grades)	Avg. percent blacknose	Avg. dry wt. per fruit, grams	Avg. height and seasonal growth of palms§, feet Feb. 1942	Nov. 1942	Growth
Very Heavy	199	25.6	21.9	8.6	10.4	12.8	2.4
Normal	181	28.0	19.8	8.5	9.9	12.1	2.2

‡ The very heavily irrigated plots received 6 acre-inches of water every 5 days during the period March 25 through October 10, 1942, and a total of 24 feet during the 1942 season. The normal irrigation plots received about the same irrigation treatment as the wet plots of the 1942 season (see table 1).

§ There were nine plots of 2 palms each in each treatment. Thus each average presented represents the mean of 18 palms.

¶ The data presented represent the means of all pickings.

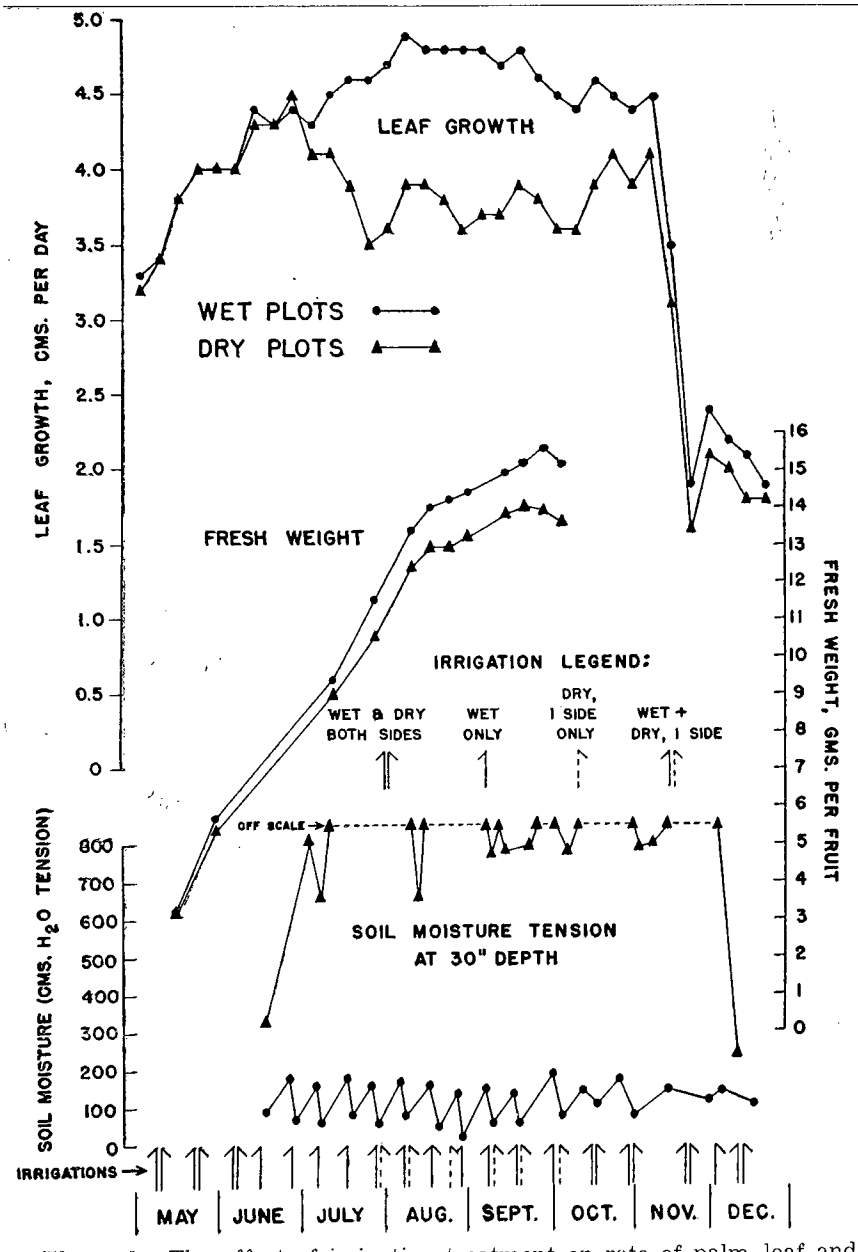

Figure 1. The effect of irrigation treatment on rate of palm leaf and fruit growth, and the moisture status of the soil.

ingly or not at all during the harvest season, which usually begins about the middle of September with Deglet Noor. A few begin withholding water even sooner. What the effect of this practice will be on the rate of growth of the palm will be determined to a large extent by the inherent moisture storage capacity of the soil in the principal root zone, and the moisture status of that soil. If palms on silty soil approach the harvest season with a good supply of soil moisture to a depth of 7 to 8 feet, it is quite possible that withholding water during harvest will not seriously reduce the rate of leaf-elongation during that period. With palms on deep sandy soil there is a definite possibility that palm growth will be reduced by withholding water during harvest. It is our plan to study this problem this coming season, and we hope to have a report on these experiments ready by next year.

INTRODUCTION OF THE MEDJHOOL DATE FROM AFRICA INTO THE UNITED STATES

By Walter T. Swingle, Collaborator, Bureau of Plant Industry, U. S. Dept. of Agriculture

Early in May, 1927, by invitation of the French government I joined a Commission appointed to investigate the much-feared Baioudh disease of the date palm in Morocco. This Commission included members from Algiers, Morocco and France, all experts in their respective lines of botany, entomology, plant pathology and quarantine procedure.

Our trip began at Erfoud, near the Algerian-Moroccan boundary, and we proceeded to Colomb Béchar where we saw the frightful ravages of the parlatoria scale, introduced without its natural enemies on a few offshoots from Algeria. This Oasis, about 12 miles long and from 1 to 2 miles wide had formerly been pest-free. Parlatoria scale spread with incredible speed throughout the oasis; the dates were only about half-size and were completely covered with scale, entirely unfit for human consumption. Hogs would perhaps have eaten them but the Arabs do not eat pork!

On our way into the heart of southern Morocco we were delayed for about a week at Bou Denib, about 100 miles east of Tafilalet, the greatest date oasis of Africa, noted for its choice Medjhool dates. We were waiting for the French army of occupation to arrange for our trip with adequate military protection, as the country was not yet fully pacified.

Here I had the good fortune to become well-acquainted with the civil and religious head of the oasis of Bou Denib where about 9000 palms were growing. He was a Cherif (lineal descendant of Mahomet) and a Hadj (having made a pilgrimage to Mecca) and his authority over the Arabs of the Oasis was practically unlimited. All dealings with the Arabs of Bou Denib by the French military authorities posted there were through him. He invited our party to a dinner served in true Arab style—delicious food but no utensils except one's fingers. One advantage of this system is that the meat must be tender to come off the bones! We had a young sheep roasted whole, many bowls filled with kous-kous, and very strong, very sweet tea. During the dinner I talked with the Cherif about the Medjhool date, the only variety exported in large quantities from Morocco to Europe. I learned to my amazement that the Arabs only received about 2 cents a pound for these dates. I told him I had bought these same dates from the original package in London for one shilling (then worth about 24 cents) a pound. I told him the Arabs should get more for their dates and he asked at once how much more. I told him if the Arabs would grade their dates for size and condition (dry or moist) and protect them from flies they should be able to get 5 or 6 cents a pound. This amount impressed him as extravagant but interested him very much. From then on, he was very eager to show me any and everything regarding the Medjhool date. I asked him if it would be possible to buy a few Medjhool offshoots to send back to the United States as we did not then have this famous variety in our country. He arranged to accompany me through the oasis with several of his men. We entered one date garden after another only to find the Baioudh disease in or near every one of them. Finally we came to one that did not show any of the pale leaves in the middle of the leafy top, characteristic of the Baioudh disease. The gardens adjoining on three sides also showed no signs of it. On the fourth side was the irrigation canal with date palms planted along it. I followed the canal back to the point where the water issued from an underground conduit excavated in the soil for miles back to the mountains. I found no trace of the disease along the canal. Thereupon I asked the Cherif to ask the owner if he would sell me a few offshoots and at what price. Without bothering to ask the owner he said in no uncertain terms, "He will sell you what you want at a reasonable price." The owner's men thereupon began feverishly to cut offshoots from the base of a Medjhool palm surrounded by offshoots. In a few minutes six standard-sized offshoots had been cut, but in their haste the workmen had knocked off five other small shoots. They told me I need not pay for these small offshoots but could use them to fill the spaces between the large offshoots when they were packed in a box. The offshoots were all packed that night at the Army post and shipped at once to the United States. They arrived in Washington about five weeks later.

The Plant Quarantine authorities of the U. S. Department of Agriculture decided that no treatment that could be devised in Washington would be sufficient to convince them that these offshoots were free from Baioudh disease, and that they must be grown for several years under strict quarantine supervision **in a state with no date palms in it!** This at first seemed an impossible condition, but an emergency survey showed that the southern point of Nevada was just the place—a good date climate, between two date states, California and Arizona, and no date palms were growing in Nevada.

Thanks to the skilful work of Mr. Frank A. Thackery, an Indian farmer was found in this region,

with a well on his place, and he agreed to grow the offshoots for us. Then we discovered his property was not inside the Mojave Indian reservation and so he had no title to the land! Mr. Thackery thereupon succeeded in getting the boundaries of the reservation changed so as to include the Indian's farm. On the 4th of July, 1927, the 11 offshoots were planted. They all grew and prospered. Unfortunately two of the small ones were dug up by the Indian's dog one day while he was away, but the rest made amazing growth. By the third year many new offshoots had developed on the original offshoots and also a few bunches of fruit were produced. It was very unusual to get fruit so early from palms heavily laden with offshoots.

I had told the Cherif about our system of packing dates so they would keep for several months. In the late summer I received a letter from him in French reminding me of my promise to send him some. As soon as the new crop was ripe I sent him a metal box of beautifully packed dates from Indio. He wrote at once to thank me and said "all that you told me was true," so I am afraid he had not altogether believed what I had told him 6 months before! He said he had only eaten four of the dates as they were so good he wanted to plant them and the Arabs believed that dates grew better if planted with the pulp. He added in ten lines of his letter more than the ten-man Commission had discovered in ten days, a list of the Moroccan varieties most susceptible and those most resistant to the Baioudh disease. Unfortunately the Medjhool was among the former and was no longer being planted in Morocco for this reason.

Knowing that the Spaniards h bought this date for centuries, ev since the Arab occupation of Spa and still send carefully packed box of them to their friends as a choi Christmas gift, I was convinced w would find a market for the Me jhool date in Madrid, and doubtl in London as well, especially if shi ments from Morocco should be cu tailed by the ravages of the Baiou disease.

A few years ago the nine Me Jhool palms and their offshoo were brought to the U. S. Gover ment Date Garden at Indio. T quarantine period was over and t water supply on the Indian's fa in Southern Nevada was no long adequate for these thirsty palm Here at the Indio Date Garden th have made fine growth, produc very many offshoots and ripen fruit of excellent quality.

DATE MANAGEMENT PRACTICES AT BARD, CALIFORNIA

By R. S. Dillman, Collins & Dillman, Date Growers

In October of 1932 there were no commercial date plantings of standard varieties in Imperial County east of the sand hills. The Bard district comprising an area of approximately 6000 acres and a part of the Yuma U. S. Reclamation project had perhaps 2000 seedling palms up to twenty years of age but most of them were receiving no cultivation, fertilization nor intentional irrigation. It was noticeable that these seedling palms were making good growth where the soil was reasonably good and were bearing hundreds of pounds of unmarketable fruit. The owner of the largest seedling planting told us that the fruit made fine hog feed. A few individuals made a practice of picking small quantities of the better seedling dates while the water content was still very high, dehydrating them in the sun or in ovens but in any event obtaining an inferior product. We were told that this process was necessary as the fruit would sour and would be eaten by various bugs if left longer on the palms. We were to learn that no one had been able to consistently produce a good commercial crop of dates in the Yuma area. This information came however after we had purchased our land. As our planting developed we were to realize that our high humidity during the ripening season was our chief problem. The higher humidity and our water table at approximately six feet we believe to be the outstanding differences in date culture conditions between the Bard area and the Coachella Valley. However the high water table lends itself to partially offset the undesirable effects of the high humidity.

The first commercial planting of standard varieties at Bard was made by Collins & Dillman in May and June of 1933. The following month the present planting of Mr. A. E. Hagberg was started and is now being operated by the Hagberg Bros. Our two plantings, a total of approximately 55 acres in bearing at present, are the only standard variety commercial plantings in the district. Another neighbor, Mr. John Hendricks, is preparing to plant ten acres of his own offshoots this season. We are fortunate indeed in having these good neighbors just as interested in growing fine fruit as we are.

The Collins & Dillman planting originally included Hayama but these were later dug out. Our varieties are Saidi, Zahidi and Khadrawi. The Hagberg Bros. have Saidi, Zahidi, Khadrawi, Halawi, and Dairi.

Before our first palms were bearing we were working on t high humidity problem. Our pre ent technique is the result of ma experiments and varies somewh on different varieties. In all t gardens our last irrigation bef the picking season is made not l ter than July 15th and no more w ter is applied until about Decemb 15th or until the manure is put and disced in. By the time t fruit starts to ripen the ground dry down far enough to quickly a sorb the water from an ordina shower. Clean culture is practic during the ripening season and w make a real effort to have t ground level, dry and clean in t entire garden. As birds are plenti and the date acreage is small must protect our bunches. We u muslin tubular covers on the Kh drawi and Zahidi and a special co on the Saidi that will be mention later. Our bunch management d fers from standard practice becau we are more limited in total pou per bunch that can be properly m tured under adverse conditio Our bunch load is governed by t amount of ventilation we can gi the berries during the ripening se son. Fluted rings are used in bunches. The longer the stra the larger the ring that can be us

d consequently the heavier the
ad that can be properly ventilated
d quickly dried out after a rain.
herefore we thin entirely from the
nter of the bunch cutting nothing
om the ends of the strands. On
e Khadrawi we use 8" rings, the
hidi 10" and the Saidi 10 and
". Our rule of the longer the
rands, the larger the ring and the
avier the safe load is reflected in
ur 1944 production of 7500 lbs. per
re on Khadrawi and 12,000 lbs. for
idi. In our thinning which av-
ages around 70% we have found
at we can safely leave 10% more
rries per bunch on the southwest
rtion of the palm than on the
rtheast. Little if any difference
size of fruit has been noticed
nce we have been using entire
rands.

The muslin covers worked very
ell on the Khadrawi and Zahidi
ut not on the Saidi. A tenth of an
ch of rain between August 10th
nd picking time would cause brown
pots and mold. After a real rain
he berries would blow up like pop-
orn. We were faced with complete
ailure on our Saidi. Early in our
experiments with covers we found
hat a tight paper cover could not
e used as the fruit would sweat
uring high humidity periods caus-
ng damage just as bad as rain as
he tight paper covers would pre-
ent the fruit from drying out
uickly. We finally were able to
make a cover for the Saidi in two
parts that protected the fruit from
ain and birds and at the same time
gave the necessary ventilation. By
imple adjustments to this cover we
can increase the temperature under
he cover as much as five degrees
during the afternoons in October and November. With the Saidi bunches protected by August 1st, damage due to excess moisture is held to a minimum. During August and September when our periods of maximum humidity usually occur the covers are adjusted to give maximum ventilation. By October 1st, we can safely cut down ventilation and increase the temperature inside the bunch to hasten maturing of fruit. These covers are not a cure-all for the Saidi. We still have some spots but the proportion of high grade fruit is such that the Saidi acreage has shown the highest net per acre the past two seasons.

Our Bard soil is usually some combination of recently deposited Colorado River silt and desert blow sand. The thickness of the top soil depends to a considerable extent on the number of irrigations that were given previous to the functioning of Boulder Dam. Each irrigation formerly deposited up to 1/8" of silt. We have no real drainage problem as our sub-soil down to the water is porous sand. This sand sub-soil also serves to protect our surface soil from salt by capillary attraction. Colorado River silt and desert sand properly mixed makes with barnyard manure a good soil.

We use the flood system of irrigation with the checks or lands leveled flat. The size of the checks vary according to the porosity of the soil and are from 1¼ to 3 acres in area, the size calculated so that using our full head of 12 second feet in each check we should get approximately the same water penetration. Our annual irrigations do not exceed 2½ acre feet and last year our net cost for water for 40 acres was $30.55. Our irrigation efficiency is gradually being improved by hauling pure silt from canal banks to be spread on spots where the soil is thin which of course causes excessive leaching. For fertilizer we have depended entirely on barnyard manure but this past winter used 5 lbs. of Am. Sulphate per palm in addition to 12 tons of manure per acre.

Apparently the only limitation of bunches per palm with our bunch and soil practices is the number of flowers available and the one of finding a proper place to hang each bunch. Last year we matured as high as 19 bunches per palm on each of our varieties. It must be remembered however that 1000 berries seems to be about our safe limit per bunch with not over 750 on the Khadrawi. It is our practice to return all trimmings to the soil and no leaves are cut off until they start to dry up. Leaves are tied to each other to make space for the bunches. On Zahidi in particular we may have 40 or more leaves below the lowest bunch.

Last year the total production of the two places at Bard was a little over 200,000 lbs. This year we expect 300,000. Most of the increase will be due to our neighbors the Hagberg Bros. who, although but recently in active management of the place, are doing a real job.

According to figures recently put out by United Date Growers our production last year seems to be slightly higher than the Coachella Valley average, it is increasing however and we expect to do better in the future.