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Date Growers' Institute

HELD IN 12

COACHELLA VALLEY

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Thirteenth Annual

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Table of Contents

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Saturday, April 18th, 1936

THE WORK OF THE UNITED STATES DEPARTMENT OF AGRICULTURE FOR THE DATE INDUSTRY

By Knowles A. Ryerson, Principal Horticulturist in Charge, Subtropical Fruit Investigations

Introductory Remarks in Opening the Thirteenth Annual Date Growers Institute

THIS is the Thirteenth Annual Meeting of the Date Growers Institute and it is a pleasure to preside over this opening session of so well an established institution. These meetings were started some years ago in order to bring together the opinions and experiences of growers, research workers and friends of the industry as they develop in our rapidly expanding industry. Ours is one of the oldest fruit industries known to man, but the oldest records we have in this country are young in comparison with our other horticultural industries. However, during the years this Institute has been held, much information has been exchanged and a great deal of progress has been made toward the development of a modern date literature. In the old world there is an extensive date literature but not in modern writing. The major portion of it is in Arabic. The experiences and discussions in these meetings and their recording in permanent form insure the basis for continued progress.

The discussions brought out in these meetings have especially emphasized what we need to know. What we do not know would fill many books. Compared to other fruit industries, we are where they were twenty or thirty years ago in regard to information and experience available. True, ours is a small industry with comparatively few growers in it, and they are located in only three states (if we count the small beginnings made in Texas recently). Practices established twenty to thirty years ago in the citrus, apple or peach industries, are just now being worked out for the date industry. We are just beginning in a small way and since the industry is infant economically in the State of California, support for reseach comes very slowly. These meetings give growers and research workers an opportunity to keep abreast of developments and to supplement and amplify the research work under way until the industry is further along and can demand more attention.

In discussing briefly the research program of the Department of Agriculture as it affects the date industry, it is dangerous, or at least unwise, to talk about what is going to be done or expected or hoped to be done. But the risk is taken in order that date growers may know some of the things the Department is attempting to do in order to meet some of the numerous problems.

The Department, having been largely instrumental in getting the date industry established here in the southwest, is still very much interested in its development. We are not out of the woods yet (or can one speak of woods in the desert?), but at least we are not out of the palms, although we have learned quite a good many things, largely the kind that indicate just what the problems really are.

Just what activities are being conducted at the Federal Date Experiment Station? Resources of the Federal, state and county governments, are not great for research work. In carrying on Federal work duplication of effort is avoided in order to stretch the work of all agencies as far as possible. The question of varieties still is one for further study, although one variety predominates the plantings, in this valley. When production problems begin to arise in any plant industry it is necessary to have a thorough understanding of how that particular plant functions, how it reacts to its environment, both in nature and when we plant it in a field or garden and handle it as an irrigated crop. We are trying to understand the functioning of the date palm so that we can build solidly toward a profitable industry.

The objective of practical research work is easy to state. It is to find out how to provide maximum crops of first quality fruit at a minimum cost of production. There are many steps in between, however, that involve many things. There is the complicated production side, the economic problems of handling and storage, and of delivery into the hands of the consumer. The Department's portion of the problem is primarily with the production end—how there can be insured a type of culture that will give, year in and year out, a maximum amount of high grade fruit at the lowest cost of production. What is being done about it? Certain lines of work, such as pollinating, thinning, etc., have been under way for some time. The same is true about studies on storage and handling, some of the results of which will be reported on in this program. These studies are being continued.

I have been speaking only for the Bureau of Plant Industry, U. S. D. A. I want to commend the Federal Bureau of Entomology and Plant Quarantine, cooperating with the State Department of Agriculture and county agricultural commissioners for their eradication of the Parlatoria scale. The Department has been very pleased to work with state and county authorities to solve this problem. The wholehearted support of the growers themselves made this eradication possible.

The study of date varieties is continuing. It is hoped that additional time may be given this year to bring up to date as soon as possible all information available as to behavior of all varieties fruiting here. The questions of cover crops, soil moisture, fertility—problems pretty well settled for other crops, but about which we know comparatively little insofar as the date is concerned,—are being undertaken. We are initiating studies that we hope will lead to helpful recommendations on these practices. Only a short progress report is possible this year on cover crop trials.

These problems will not be solved in one or two years. Recommendations cannot be made on the conclusion of any one season's results. They merely indicate the nature of the work under way. Growers have the opportunity of seeing these tests at the Government Station and of giving us the benefit of your own experiences so that we may direct our activities more intelligently. Preliminary studies on soil moisture have been started, in which we will appreciate grower cooperation in translating our findings into commercial practice.

Then there is the problem of pruning. It may seem unusual to talk about pruning date palms, but the relation of leaf surface to production is undoubtedly just as important with this fruit as with others. Studies have been started to ascertain just what effect leaf surface variation may have on the crops each year. A beginning has been made on fertility investigations. Here, again, we know comparatively little concerning proper fertilizer practices. It is a long time study and many factors have to be considered in planning and carrying out this type of investigation. The U. S. D. A. is not undertaking pathological work at the Indio Station, as Doctors Fawcett and Bliss of the Citrus Experiment Station have this field well in hand.

These, in brief, are our intentions as to the type of work we are undertaking. It is not an elaborate program. The detailed organization of projects underway at the Government Station are of a necessity omitted in an introduction such as this. The program will undoubtedly develop and change, as research programs generally do, but the objective remains the same: to attain a maximum of quality production at the lowest cost.

There is in this valley one of the finest opportunities in this country for a united and successful fruit industry. With grower cooperation among themselves and with the research agencies of the Federal and State governments, the future of the date industry should be bright.

Rhizosis, A Recently Discovered Disease of Date Palms (1)

By Donald E. Bliss, Assistant Plant Pathologist, University of California, Citrus Experiment Station, Riverside, California

IN January, 1933, the writer was called to a date garden near Indian Wells to see a Deglet Noor palm which was dying rapidly. This tree was about 15 year of age and stood 23 feet high at the fiber line. Trunk growth of more than two feet had occurred during 1932 and 11 large bunches of fruit had developed. About the time when the fruit reached the khalal stage, the lower leaves began to die. By January the number of green leaves had decreased from more than 100 to about 15. The youngest leaves were dead and of a whitish color, and the date fruits had shriveled prematurely. On examination nearly all of the roots were found to be dead and of a dark brown color. Necrosis extended to the base of the roots, involving a layer of trunk tissue about two inches deep. The roots and surrounding soil were so wet that the disease was tentatively attributed to over-irrigation from a leaky standpipe nearby.

During the months of June, July, and August, 1933, six Deglet Noor palms, one Thoory, and one seedling male developed similar disease symptoms and all died within six months.

These palms were situated in four different gardens within a radius of one-half mile from the palm first affected. The disease was not found in groups of trees but appeared in individual palms which in most cases were surrounded by healthy individuals. Two additional cases of the malady appeared near Indio during the autumn of 1933. In 1934, new outbreaks were studied in two gardens situated southwest of Coachella, and in 1935, palms showing symptoms of the disease were observed near Palm Springs, near Garnet, and in the central portion of Coachella Valley.

The writer has examined thus far 21 typically diseased palms situated in ten different gardens. More or less questionable cases have involved 11 palms in seven other properties. The disease has caused considerable alarm among certain growers, owing to the loss of valuable palms and because of the potential danger of its widespread occurrence. Since no information was available regarding this new malady, the writer began an investigation to determine its cause and, if possible, to bring it under control. The present paper is preliminary in nature, reporting studies which cover a period of three years. A description of the symptoms will be followed by an account of isolation and inoculation experiments which bear on the cause of the disease and a progress report on certain control measures.

Symptoms

The disease of date palms which constitutes the subject of this paper has been given the name "rhizosis," which means "disease of the roots." The first visible indication of rhizosis is usually the death of the oldest leaves. The pinnae turn brown at the tip end, and necrosis progresses rapidly inward toward the trunk. The leaves on all sides of the palm may die in rapid succession if the weather is very hot and dry. If the weather is cool and less desiccating the process may be temporarily interrupted. If the affected palm is fruit-bearing, another early symptom is the sudden wilting of the fruitstalks. Many fruits may fall from the strands, while others remain in a shriveled or stunted condition. The fruitstalks usually die prematurely and the fruit is worthless. Necrosis begins at the distal end of the fruit strands and progresses inward toward the trunk. These early symptoms of rhizosis are similar to those which might result from transplanting a large unpruned palm to dry soil during hot weather. However, rhizosis may develop where the soil moisture is maintained at a desirable level, and where other cultural factors seem favorable to normal growth.

Death of the youngest leaves in the crown constitutes a characteristic symptom of rhizosis that usually develops after many of the older leaves have died. These young fronds with folded pinnae dry out and assume a whitish color. At first the bases of these leaves appear flaccid but free from fungus attack. Later, they become sour-smelling and rotten, owing to the invasion of various fungi, bacteria, and insect larvae in the region of the terminal bud. Finally, when all of the leaves have died, the trunk will bend slowly to one side as decay progresses downward from the terminal bud.

A better understanding of rhizosis

(1) Paper No. 302, University of California Citrus Experiment Station and Graduate - School of Tropical Agriculture, Riverside, Cal.

was obtained by the dissection of a palm showing early symptoms. A Deglet Noor palm which stood about seven feet high at the fiber line and had lost about half of its leaves was dug out, together with a large mass of roots. Cross cuts which were made through the trunk, one just below the terminal bud and the other at the soil line, showed that the tissue of the trunk, of the terminal bud, and of the leaf bases was alive and apparently free from fungus invasion. From 20 to 50 per cent of the roots, when cut at a distance of one foot from the trunk, were brown and dead. Closer examination of these brown roots showed that necrosis had originated in them at some distance from the base of the palm and that it had advanced inward toward the union of the root with the trunk. At the time of dissection there were many affected roots in which necrosis had extended to a point within four to six inches of the trunk, but at no place had it actually progressed into the trunk. When examined microscopically the necrotic root tissue was found to be thoroughly invaded by fungi, the xylem ducts being plugged and darkened with fungus spores and hyphae. Dark brown spores were found within cells of the cortex and central cylinder.

Etiology

That rhizosis was essentially a root disease but that the casual agent was obscure was recognized early in the present investigation. Specimens of roots were taken from nearly all of the diseased palms which were examined, and numerous cultures of microorganisms were isolated. These cultures included Phomopsis phoenicicola Trav. and Spessa., Diplodia phoenicum (Sacc.) Fawcett and Klotz, Trichoderma lignorum (Tode) Harz, Rhizoctonia solani Kuhn, Rh. bataticola (Taub.) Butler, Rhizopus nigricans Ehr., Aspergillus niger v. Tiegh., Ceratostomella sp., Fusarium spp., Penicillium sp., Cephalosporium sp., Mucor sp., Helminthosporium sp., bacteria, nematodes, and several unidentified forms.

The first studies which were made on the fungi associated with dead roots were begun after the affected palms had reached the later stages of rhizosis. The roots of such palms were mostly dead and already invaded by many common soil organisms which were apparently of no primary importance. At one time, Phomopsis phoenicicola and Diplodia phoenicum were thought to be causal agents because they were encountered so commonly in the necrotic roots. However, seedling palms which were grown in soil artificially inoculated with these cultures, singly or in combination, failed to develop lesions on the roots. Soil inoculations with at least seven other species of fungi were equally unsuccessful.

One fungus, however, proved to be highly pathogenic on experimental plants. This organism was identified tentatively as Ceratostomella sp. (2) Although the principles which govern the infection of date palms are poorly understood, this fungus can probably best enter its host through wounds. Artificial inoculations in controlled experiments demonstrated that Ceratostomella sp. can produce rapid necrosis of leaf-base tissue when inserted through wounds. Potted plants in the 5- to 10-leaf stage were much more susceptible to infection when wounded than when not wounded. In such experiments a pure culture of the fungus growing on 80 cc. of Pillsbury's bran was mixed with the upper 1-inch layer of soil in large pots containing seedlings of Deglet Noor date palm. Wounding was done by making a superficial cut below the soil line in the base of one of the older leaves. In certain cases, seedlings thus inoculated were killed within 20 days. The fungus penetrated rapidly to all basal parts of the plant, including the roots. Infected tissue in the roots resembled that which was taken from large, naturally infected palms in Coachella Valley. Eighty-six experimental plants were inoculated with Ceratostomella sp. Of the 45 which developed disease symptoms, 30 had been wounded at the time of inoculation.

Evidence is now at hand which strongly suggests that Ceratostomella sp. is the primary cause of rhizosis. This fungus was isolated from ten diseased palms in seven widely separated date gardens. One of these palms was dissected when in an early stage of the disease. As described above, the only lesions to be found in the tree were situated in the roots. Bits of tissue taken aseptically from the advancing margin of these necrotic lesions yielded Ceratostomella sp. in 11 out of 14 cases. Some of the cultures contained only Ceratostomella sp., while others included mixtures of Trichoderma lignorum, Fusarium ispp., Verticillium sp., bacteria, nematodes, and mites. Perhaps the most incriminating evidence against Ceratostomella sp. was the discovery of its mycelium and spores within the xylem ducts to points up to two inches beyond the advancing edge of the necrotic lesions. The dark brown macrospores of the fungus had developed so profusely within these large vascular elements of the central cylinder that the dark streaks formed therein were easily visible to the naked eye. Ceratostomella sp. has been shown to be highly pathogenic to date palms, and it is the only organism associated with rhizosis which produces in experimental plants symptoms which are similar to those of rhizosis; hence it seems probable that Ceratostomella sp. is the primary cause of this disease.

Experiments on Control

Efforts to control rhizosis in two large palms by the application of 50 pounds of copper sulfate to the soil about each of their bases resulted in failure. Likewise it was found of little or no avail to cut off the fruit-stalks and most of the leaves from affected palms. Partial recovery of affected trees was observed only in cases where winter weather developed while the palms were still showing early stages of the malady.

Preventive and curative measures are as yet unknown. The problem of disinfecting soil from which diseased palms have been removed was taken up recently. Root segments of date palm artificially infested with Ceratostomella sp. were buried in galvanized iron cans and treated with various chemicals in the manner outlined by Bliss (3) in disinfection experiments against Omphalia sp. The results of this experiment are preliminary but they indicate the difficulty of the problem involved. The moldy root segments were removed from the soil 33 days after it had been treated with the various disinfectants. Tissue plantings taken aseptically from the central cylinder of each root were made on cornmeal agar slants to test the viability of the fungus. Since none of the disinfectants used were entirely effective in killing the fungus within these roots, it is sufficient at this time merely to list the chemicals and the largest doses of each which were applied. These were as follows:

(2. A full description of this fungus is being prepared for publication in another place. The imperfect stage of the pathogen apparently belongs to the form genus Chalaropsis Peyr., but is distinct from the type species Ch. thielavioides Peyr. The perithecia form readily on cornmeal agar from pure cultures of the Chalaropsis stage and, conversely, the ascospores from the perithecia give rise to the asexual macrospores and endospores of Chalaropsis.

(3) Bliss, Donald E. Soil disinfection as a means of combating decline disease in date palms. Date Growers' Inst. Ann. Rept. 12:13-16. 1935.

Chemical	Amount applied per sq. ft. of surface
Carbon bisulfide - -	0.5 liquid ounce
Chloropicrin - - -	0.169 " "
Dichlorethyl ether -	1.0 " "
Chlorine - - - -	0.712 pound
Sulfur dioxide - -	0.643 "
Ethylene oxide - - -	0.10 "
Ammonium hydrate	7.48 gallons of 1,000 p. p. m. ammonia in water

Among these treatments, chloropicrin, chlorine, and ethylene oxide seemed most promising. The same experiment (4) demonstrated that Ceratostomella sp. is considerably more difficult to kill in buried root segments than are Omphalia sp. (decline-disease fungus) and Armillaria mellea (Vahl.) Sacc. (5) (oak-root fungus) in roots similarly placed and treated. The reason for this difference is probably explained by the fact that only Ceratostomella sp. produces spores within the tissues.

Summary

Rhizosis, first observed in 1933, is known only on date palms in Coachella Valley. Thus far, 21 typically diseased palms have been examined in ten different gardens; eleven questionable cases have been located in seven other properties.

The symptoms of rhizosis include a rapid wilting and dying of the leaves and fruitstalks and necrosis of the roots. A fungus, Ceratostomella sp., was isolated from ten diseased palms in seven date gardens. It was shown to be highly pathogenic and to reproduce symptoms in the roots of experimental palms which were similar to those of naturally infected individuals. The evidence now at hand suggests that Ceratostomella sp. is the primary cause of rhizosis.

No control measures have been discovered which will prevent or cure the disease. A preliminary experiment on soil disinfection indicated that Ceratostomella sp. is comparatively resistant to the lethal action of certain soil fungicides.

(4) Bliss, Donald E. (Further experiments on soil disinfection). Unpublished data. 1936.

(5) This was on citrus roots. Armellaria mellea has not been found on date palm roots in California.

Further Experiments In Fruit Thinning of Dates

By Roy W. Nixon, Associate Horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture

THE fruit thinning experiments with Deglet Noor dates reported at the Twelfth Annual Date Growers' Institute were continued during the past season under somewhat different conditions. The tests were carried out in cooperation with Mr. B. S. Boyer in his date garden two miles west of Indio, using 30 Deglet Noor palms planted in 1928 with 10 palms in each of three treatments. Instead of the extremes of no-thinning and very severe thinning, both of which were shown in 1934 to be sources of considerable loss to the grower, the gradations planned this season were: (1) light thinning—cutting out 15 per cent of the strands from the center and removing 10 per cent of the remaining flowers by cutting back the tips of the strands; (2) moderate thinning—cutting out 30 per cent of the strands from the center and removing 30 per cent of the flowers at the tips; and (3) moderately severe thinning (referred to subsequently as "heavy" thinning)—cutting out 30 per cent of the strands from the center and removing 50 per cent of the flowers at the tips. If all the strands carried the same number of flowers this would give a theoretical reduction of 23.5 per cent, 51 per cent and 65 per cent respectively, but as there are fewer flowers on the center strands than on the outside ones the actual reduction would be somewhat less. However, as pointed out last year, it is hardly possible with dates to do more than approximate any definite percentage of reduction because most of the thinning must be done before the set and subsequent shedding are determined. The thinning was delayed for a few days after the pollination of individual clusters to facilitate a more accurate percentage reduction based on estimates from flower counts of a few typical strands, but for all practical purposes it may be considered as thinning at time of pollination. Thinning June 1st was abandoned this season as aside from the decreased effect on size it is impracticable on a large scale to do all of the thinning at that time.

In the summary of experimental data the theoretical reduction is assumed for the percentage reduction in the light thinning treatment and the comparative reduction percentages for the other two treatments are based on this in relation to the estimated number of dates per bunch. The data show the total reductions of fruit per bunch to be very close to the standards set for the experiment. The number of dates per bunch and the percentage of shrivelling, blacknose and checking were estimated from a count and examination of individual dates on three typical strands of every bunch just prior to the first picking in September.

The percentage of fruit set, as checked on June 8th, was found to have been decreased in proportion to the degree of thinning. The slight differences, apparently of no commercial importance, are probably explained by a previously observed tendency for a better set to occur near the tips of the strands than near the base, possibly due to more exposure to pollen. Incidentally, the set this season was somewhat below normal on these palms, as was the case very generally in date gardens throughout the Southwest.

There was little difference in shedding between June 8th and July 16th, but between July 16th and September 18th there was a slight but consistent increase in the amount of shedding proportionate to the amount of thinning. In 1934 shedding was also shown to be increased by thinning, but no data was obtained as to the time when the shedding occurred.

Shrivelling was more or less conspicuous in the light thinning treatment, although much less pronounced than in the case of the unthinned dates the previous season. Blacknose and checking were again proportionate to the amount of thinning, enough to be a distinct detriment in the case of heavy thinning.

The fruit in this experiment was picked commercially along with the rest of the garden but segregated for weighing in each treatment. The average yield per bunch was calculated from the total yield divided by the number of bunches. The records show that in spite of smaller bunches moderate thinning resulted in only a slight decrease in the total number of pounds per bunch as compared to light thinning. This was due partly to the increased size of individual dates on the one hand and partly to the increased amount of shrivelling

on the other, much of this shrivelled fruit being thrown aside by pickers. Heavy thinning, in which the number of dates per bunch was 44.8 per cent less than in moderate thinning reduced the yield per bunch 32.5 per cent below the latter.

As in the previous year, grading was based on random samples of 100 dates per palm from each picking with A, B, C grades and culls. The data show that moderate thinning resulted in an actual increase in pounds per bunch of both A and B as compared with light thinning. The percentage of A grade from heavy thinning was almost the same as from moderate thinning, whereas there was a slight increase in the percentage of B grade, but in both cases the yield per bunch was much lower because of the reduction in size of bunches. A tendency for some dates to ripen imperfectly was observed in the light thinning treatment but much less pronounced than in the unthinned treatment the previous year.

The average length of dates, which increased in proportion to weight, was calculated from measurements of 10 dates from each palm between the second and third pickings. Although size was not considered in grading, the weight and length data indicate that the percentage of fruit which might have been disqualified for size in the light thinning treatment was probably negligible.

The effects of the three thinning treatments on time of ripening were estimated from a graph of the picking records. Light thinning resulted in a definite retardation in ripening of approximately two weeks as compared with moderate thinning. Heavy thinning resulted in only a very slight acceleration of ripening as compared with moderate thinning--less than a week.

In comparing these experimental data with the results from the preceding year it appears that the flower clusters in the experiment at Boyer's were slightly smaller than the flower clusters in the experiment at Krutz' and there were consequently fewer dates per bunch in 1935 in spite of a percentage reduction probably slightly less than in 1934. Although the moderately thinned treatment at Boyer's had 253 dates less per bunch than the corresponding treatment at the Krutz garden the previous year, taking into consideration seasonal differences the two treatments in different gardens in successive years appear to be quite comparable and somewhere near the most desirable size crop for the palms in question. It so happens that the age of the palms was the same in both experiments, the Boyer palms having been planted one year later than the Krutz, but the latter were in slightly more vigorous condition and able to carry a somewhat larger crop than the former. This points to vigor of palms as a factor in determining the crop that should be carried rather than an arbitrary number of dates per bunch. Fertilization, irrigation and cultural management undoubtedly enter into the picture and the extent to which variations therein might modify the results of thinning experiments is open to question. However, due to the fact that younger or less vigorous palms commonly produce fewer and smaller spathes than older or more vigorous palms the same percentage reduction will leave the clusters proportionately smaller on the former than on the latter and whatever further adjustment seems desirable can be made by removing entire bunches.

Experiments with methods of thinning as between different bunches on the same palm were made at the U. S. Experiment Date Garden in 1935 with Deglet Noor, Kustawy, Halawy and Barhee. With Deglet Noor the results indicate a greater increase in size from cutting back the tips of strands than from removing entire strands. Since the removal of entire strands is almost a mechanical necessity to facilitate the handling of large bunches, this gives experimental confirmation of the current practice as commercially evolved--cutting back the tips of all strands and cutting out entirely some strands from the center. The results were somewhat comparable with the soft varieties, but as the data are less conclusive further tests are being made in 1936.

With Deglet Noor a number of experiments were made with different degrees of thinning on different strands on the same bunch. The data indicate that larger fruit is produced on an individual strand when it is cut back to a few dates without apparent correlation with the total number on the bunch. In other words in thinning for size the number of dates per strand is more important than the number of dates per bunch provided the bunch is not overloaded.

Relative to the effect of one season's crop upon the number of flowers produced the next spring, the following data were recorded in 1935 for the 10 palms in each treatment of the thinning experiment at Boyer's: those used for light thinning produced 170 flower clusters and matured 99 bunches; moderate thinning, 147 flower clusters and 104 bunches; heavy thinning, 166 flower clusters and 122 bunches. On April 15, 1936, with the flowering season practically over flower clusters had been produced on the same palms as follows: light thinning, 94; moderate thinning, 110; heavy thinning,

SUMMARY OF EXPERIMENTAL DATA FROM BOYER'S GARDEN - 1935

	Light thinning	Moderate thinning	Heavy thinning
Average number of dates per strand	29.6	22.1	12.2
Reduction of dates per strand—percent	10	37.4	62.8
Average number of strands per bunch	41.9	37.2	37.2
Reduction of strands per bunch—percent	15	24.7	24.5
Average number of dates per bunch	1240.2	822.1	453.8
Reduction of dates per bunch—percent	23.5	49.3	72.0
Reduction of dates (compared to light thinning)		33.7	63.4
Dates set per bunch, June 8, average percent	60.2	55.1	50.8
Dates shed per bunch, 6 8—7 16 " "	12.8	11.2	14.2
Dates shed per bunch, 7 16—9 18 " "	5.5	7.9	17.0
Premature shrivelling--percent	6.8	2.7	1.0
Blacknose — percent	0.8	2.6	12.1
Checking — percent	11.6	20.4	33.5
Average yield per bunch—lbs.	15.76	14.75	9.96
Reduction of yield per bunch—percent	0	6.4	36.8
Increase in average weight per date—percent	0	14.9	37.2
Average length of dates—inches	1.58	1.67	1.78
Grade yields (size not considered)			
A: Percent	5.3	8.0	7.7
Average number lbs. per bunch	0.84	1.18	0.77
Average number dates per lb.	42.39	37.80	32.63
B: Percent	32.8	36.9	40.1
Average number lbs. per bunch	5.17	5.44	3.99
Average number dates per lb.	45.36	40.50	34.36
C: Percent	45.2	42.9	43.2
Average number lbs. per bunch	7.12	6.33	4.30
Average number dates per lb.	52.74	43.20	36.29
Culls: Percent	16.7	12.2	9.0
Average number lbs. per bunch	2.63	1.80	0.90
Effect on ripening (estimated from graph)			
50 percent ripe by	Oct. 21	Oct. 10	Oct. 7
75 percent ripe by	Nov. 6	Oct. 22	Oct. 18
90 percent ripe by	Nov. 27	Nov. 5	Oct. 29

139. This verifies the results at the Krutz Ranch as reported last year, indicating that a heavy crop one year (not the number of flowers borne) tends to reduce the number of flowers that appear the next spring.

In connection with the experiment at the Krutz Ranch it may be of interest to note that in the row unthinned in 1934, 2 of the 8 palms which failed to flower in the spring of 1935, produced off-season blooms in the summer of 1935, 1 having 3 and the other 4. Also in the row moderately thinned in 1934, 1 palm that produced 9 blooms in the spring of 1935 had 1 summer bloom and 1 palm that had 2 blooms in the spring had 2 summer blooms. Out of the 44 Deglet Noor palms in this experiment none that had 10 or more blooms in the spring of 1935 produced off-season blooms the following summer. From this evidence, even though rather meager, it seems probable that much of the summer flowering which occasionally gives concern to date growers may be traceable to a light crop of flowers the previous spring which in turn may be due to a very heavy crop the year before.

Summarizing the results of the two years' thinning experiments with Deglet Noor, this variety as cultivated in the Southwest regularly produces more dates per bunch than it can properly mature, as indicated by the premature shrivelling of a large proportion of the fruit when it is insufficiently thinned. Until the number of dates has been reduced to the capacity of the bunch and palm there has been a more or less definite retardation of ripening with a tendency for many dates to ripen imperfectly and the palms in question tend to lay out or produce a smaller crop of flowers the following year. After the number of dates has been reduced to the point where the bunch can mature them properly the effect of further thinning on time of ripening has been slight. The size of fruit has been increased in proportion to thinning, tending to be correlated inversely with the number of dates per strand. Thinning has been shown to increase the amount of shedding, blacknose and checking. The increased percentage of blacknose resulting from severe thinning has proved a distinct detriment tending to offset any advantage from extra large dates or what might otherwise be an increased percentage of higher grade fruit. Best results have been secured from a total reduction of approximately 50 to 60 per cent in number of dates per bunch, most of the thinning being done at time of pollination. Thinning up to this point has been largely compensated by increased size of fruit with a larger proportion of higher grades and a decreased percentage of culls. Thinning beyond this point has curtailed yield without compensating advantages.

Differences In Date Culture In Different Places

By V. H. W. Dowson, Superintendent of Kut as-Sayyid Estate, The Hills Brothers Eastern Company, Inc., Basrah, Iraq

I. Introduction

I APOLOGIZE sincerely for my failure to be present last Saturday at the meeting of the Date Institute,* and hope that, as my failure was due to causes beyond my control, my apology may be accepted. I next wish to thank very heartily indeed the organizers of the Institute for their courtesy and kindness in giving me this opportunity of addressing the date growers of California.

As it is in California that there has been carried out most of the world's total of scientific work on dates, and as it is here that chemists, entomologists, botanists, and mycologists, have turned their attention to date problems, it would have been presumptuous of me to have tried to address you on subjects about which they are better qualified than I. Consequently, I have chosen a subject on which my wanderings in several date growing countries should have provided some information which is probably not widely known and which appears to have been hitherto imperfectly recorded and which, I hope, will therefore not be without interest, namely, differences in date cultivation in different places.

Because the factors which influence plant life are numerous, complex, and interdependent, and because agricultural experiment is still in its infancy, a comparison of cultural methods forms a valuable study in the case of any cultivated crop, but it is especially useful in the case of a crop like dates, which has been the subject of but little exact experimentation and which is slow of growth and hence slow to indicate the advantages or disadvantages of any particular method of treatment.

II. Planting

a. **Removal of shoots.** The usual practice is for all shoots to be removed from the parent stem as soon as they are fit to be planted out. There are, however, exceptions, notably in India (Sind and the Punjab), the 'Iraq (lower middle Euphrates), and in some of the oases of Arabia (e. g., Jabrin), where the shoots are not removed, and where as a consequence, several trunks grow from each parent root stock to form family clumps. It would seem as though date growers as a whole were agreed that the early removal of shoots resulted in heavier date production than their non-removal, and it would seem as though it were only special circumstances which caused their non-removal to be profitable. What these special circumstances are is not known for certain but the following guesses are hazarded:

1. In northern India, date palms are grown round the fields, to which they form hedges. The thicker the growth of shoots at the bases of the palms, therefore, the more effective are the hedges as wind-breaks and for keeping out cattle.

2. In the 'Iraq, those palms which grow up as family clumps are generally those in the rice fields. Perhaps it is the difficulty of establishing new shoots in such situations which makes the cultivators loath to remove shoots from a palm which has managed to establish itself. Perhaps also widely spaced clumps give nearly as heavy a yield of dates as more closely planted single stems and interfere less with plowing and leveling for the rice.

3. In the case of oases so isolated and so seldom inhabited as Jabrin, it is probable that the lack of a settled cultivating population leads to the omission of almost every cul-

*Mr. Dowson, who was prevented by sickness from appearing on the program of the Date Institute as scheduled, delivered this address at a special evening meeting arranged a week later.

tural operation. Hence shoots are allowed to grow out as they will.

b. **Size of Shoots at Removal.** In Basrah, the size of shoot preferred for planting is such that one man can just carry it. In 'Uman on the other hand, very small shoots are planted. In Baghdad, the usual size is between that of Basrah and that of 'Uman. It is perhaps true that the sooner a palm is disembarrassed of its shoots, the sooner it will reach its maximum fruit production. True or not, it certainly seems to be the assumption on which most date growers act. One would, therefore, expect they would plant out their shoots as soon as their shoots were big enough to stand alone. The differences in the sizes of the shoots at planting in the three districts of 'Uman, Baghdad, and Basrah may, therefore, be expected to be due to differences in the conditions to which the newly-planted shoots are subject. In fact, the climatic conditions of Basrah are far more adverse to plant life than those of 'Uman and somewhat more so than those of Baghdad. 'Uman, for the most part, has a warm winter, gentle breezes instead of fierce winds, and a light soil free from salt. Both Basrah and Baghdad are subject to frost in winter and in summer to intense dry heat together with dust-laden, scorching winds. Basrah suffers from the additional disadvantage of a heavy, difficult soil, impregnated with salt. The concentration of the salt usually decreases from the surface downwards, so big shoots which can be planted deep have a better chance of sweet soil for their feeding area than smaller shoots whose roots must grow out closer to the surface. It should be mentioned here that a small shoot is preferred in Basrah only when it is to be planted in water-logged soil with the water table close to the surface. In such a situation, of course, the only chance of survival a shoot would have would be if its roots were in the top, and drier soil.

c. **Drying Out of Shoots.** The practice of drying out shoots before planting seems to have been employed only in California and there only for a short time. In general it may be said the date grower tries to reduce as much as possible the delay between removing the shoots from their parents and planting them out. The practice at the Kut as-Sayyid Estate is for the shoots to be cut in the morning, left in the water channel while the men lunch, and planted out the same afternoon. I learned at Singapore, a few weeks ago, that Pineapple shoots there are dried out for a week or so before planting to prevent their decay on planting. Was it, by any chance, the example of the Malayan pineapple grower which influenced Californian date growers in their methods of twenty years ago?

d. **Nurseries.** In California it was formerly recommended that shoots be planted in nurseries before being planted out in their permanent positions. The only district in the old world where it is commonly done, as far as I know, is in the 'Uman. Elsewhere it appears to be the normal practice for the shoots to be planted direct into their permanent positions. It is possible that the scarcity of water makes the use of nurseries in 'Uman desirable. An acre of land containing fifty shoots needs 560 yards of surface irrigation channel to provide them with water, whereas, if the same number of shoots were planted at two foot intervals, they would need only 35 yards of channel. Whether or not the lightness of the soil in the 'Uman is an advantage in transplanting is not known, because it is not known if the roots of a transplanted shoot ever live, or if the old ones always die and new ones are put out.

e. **The Level at Which Shoots are Planted.** In Basrah and Baghdad, shoots are usually planted at the surface of the ground. In 'Uman, they are frequently planted in pits, while, in the rice-growing districts of the upper Shatt al-'Arab, the lower Tigris, and the lower Euphrates, they are often planted on small mounds. The reason for the mounds is not difficult to find: it is certainly in order to raise the roots of the shoots out of the water of the rice fields; but what is the reason for the pits is not so clear. It may be to get the shoot as near the subsoil water as possible. On the other hand, at Baghdad, where the subsoil water is also low, the shoots are never planted in pits. A more likely explanation is that the pits which eventually become filled with earth and debris help to support the grown palms. That palms seem to fall in 'Uman more than elsewhere lends color to this explanation. It is a common sight to see "leaning palms" supported by two dead trunks propped against it, making, with the living one, a tripod.

f. **The Protection of Shoots.** In Basrah, dried rushes are usually used for wrapping around the shoots, till they have reached about their third year of separate life. In Baghdad, dried liquorice bushes are used; in 'Uman, nothing. Here again, it would appear that it is the milder climate of 'Uman which is responsible for the difference between 'Umani and 'Iraqi practice. In 'Uman, the warm winters and the humid summers, undisturbed by scorching, dust-laden gales, make the wrapping of the shoots unnecessary: in the 'Iraq, without protection, the shoots would certainly die, if not by the frost of winter, then by the **simum** or **khamsin** of summer. Dried rushes make a better protection than dried liquorice, but the former, though they can be floated **down** to Basrah from the marshes where they grow cheaply enough, yet would cost a great deal, if they were carried **up** against the stream to Baghdad.

g. **Replanting.** In 'Uman, I have seen a palm of about 30 years old being replanted at a lower level. Two holes were dug on opposite sides of the palm and made to meet below its trunk. The pit so formed was deepened until a gap of nearly six feet was made between its bottom and the bottom of the palm. The earth on the two sides of the palm on which holes were not made was next cut through and the palm fell vertically to the bottom of the pit. Earth was now rammed around the trunk, and the lowering, or replanting, was complete. I was told that this is a common practice in the case of palms which had arrived at middle age and had become shy bearers; but I did not learn if the reason the bearing improved after treatment was because the roots were brought nearer the water level, or were brought through a hard pan, or was something else. I have never heard of palms being so treated in the 'Iraq.

III. Spacing

In 'Uman, North Africa, and in the U. S. A., the usual planting rate is about fifty palms an acre, that is to say at the corners of thirty foot squares. In Basrah, the rate is from 100 to 120 palms an acre, say at the corners of twenty-one foot to nineteen foot squares, while at Baghdad, the rate is intermediate between that of Basrah and that of the rest of the date-growing world. The close planting of the Basrah date grower has been attributed to ignorance; but I am inclined to consider it should be attributed to his wisdom. No other date-growing district suffers from such continuous and such fierce summer winds. These blow more days of midsummer than not from the northwest, over a thousand miles of scorched desert, gathering force as they travel southward and destroying vegetation as they go. Their

influence can be readily indicated by a chart showing the daily pickings of cotton throughout a season: instead of the graph of a single normal curve, **two** normal curves result with a blank between them, indicating that the flowers which matured before the advent of the hot winds produced bolls, and that the flowers which matured after the advent of the hot winds produced bolls, but that the flowers which matured during the hot winds fell off and produced no bolls. Date palms are less sensitive indicators of changes in climatic conditions than cotton bushes, but they, of course, react to such changes, although their reactions may be invisible to the ordinary observer until the passage of time has caused an accumulation of reaction effects. Twelve blocks of palms at the Kut as-Sayyid Estate were planted from 1925 to 1928 at rates varying from 48 to 145 per acre. The growth of the widely spaced shoots has been in every case slower than that of the closely spaced ones and the acre yield has been far lower. There are indications that the closest plantings are too close for the most satisfactory growth of the palms as they become adult, and that the most satisfactory will prove to lie between 100 and 120 an acre, that is to say at about the normal for the Basrah district. The slightly wider spacing of palms in Baghdad is probably a result, not of any climatic difference, because the hot winds of summer are there hardly less devastating than they are in Basrah, but of the prevalence there of a stouter variety of palm than the commoner ones in Basrah. Out and away the commonest date variety in the Baghdad district is the Zahdi, one of the biggest of palms, while the commonest in Basrah is the Usta'amran, a smaller palm, mixed with Hallawi, Khadrawi, and Dayri, all smaller palms.

IV. Cultivation

a. **Digging or Plowing.** On the Shatt al-'Arab date gardens are usually cultivated once in four years. In early summer, the water supply is cut off and the garden dug not less than two spits deep, generally to a depth of at least eighteen inches, and then left dry for a month or so, at the end of which period, the land is again dug over and levelled and manured. Manure is given to each palm individually: a trench is dug around it four or five feet away from the bole and to such a depth that the normal subsoil water table is reached, generally at about three feet. A very large number of roots are cut off at each manuring. In Baghdad and in most places in the 'Iraq except on the Shatt al-'Arab, date gardens usually receive either an annual digging to a depth of one spit or an annual plowing, never the deep double digging of the south; and manure is usually worked lightly into the surface soil. In 'Uman and in North Africa, especially in the oases in the hills, cultivation is generally much more frequent than in the 'Iraq. In some places the surface soil will be turned over after every two or three irrigations.

At first sight, the Shatt al-'Arab method of cultivation, causing, as it does, the palms to give a reduced yield during the autumn immediately following the digging, appears exceedingly ill-advised. It would seem, however, that the key to understanding the method is provided by the manuring. Basrah date gardens are not normally watered from the surface downwards, but from below upwards, by tidal water brought twice daily from the Shatt al-'Arab by a multitude of tiny canals. Every group of six palms has its own canal, not raised, but sunk below the level of the ground. As the tide rises at the head of the Iranian Gulf, the fresh water in the Shatt al-'Arab, brought down by the Tigris and Euphrates, is banked up and flows out through the myriad little channels which form a net-work through the gardens. In general, therefore, the soil in Shatt al-'Arab date gardens is dry to a depth of about three feet. The palm can make no use of dry manure in dry soil, so the cultivator is forced to put the manure down into the wet soil. It is apparently considered that the disadvantage of the injury to the root system is outweighed by the advantage of providing the palm with plant food. On the Kuta s-Sayyid Estate the difficulty has been overcome by the employment of an engine and pump to irrigate the palms from the surface. The manure is dug lightly in and the land watered. On seventy acres of the estate not commanded by the pumped water supply, the local method is followed with one difference: instead of digging a deep trench for the manure all around the palm, a deep trench is dug only on two opposite sides. The other two sides are left untrenched until the next triennial digging. (On the estate, digging is triennial, not quadrennial). Then, these are trenched, and the two sides trenched formerly are left untouched. In this way it is hoped to cut off only half as many roots at each digging as would be cut off if the local method were applied in its entirety. The reason the usual period between cultivations in Basrah is as long as four years is probably because it has been found that in a shorter period the damage done by cutting the roots outweighs the benefits of the manuring. Also the deep cultivation and manuring is exceedingly expensive. Although the necessity of manuring, and hence of drastic trenching, is probably the main reason for cultivation being carried out only once in four years, and therefore having to be exceedingly thorough, there are two other reasons why cultivation has to be far more thorough than in other places: one, the excessive hardness of the soil, and two, the prevalence of **halfah**, the **lalang** of Malaya, and one of the hardest of grasses to eradicate. When the Tigris and Euphrates flood in spring, owing to the melting of the snows in Armenia, the water table in the Shatt al-'Arab date gardens rises almost, or quite, to ground level, and then falls rapidly, leaving the soil to be baked by the summer sun. The soil, being the last to be deposited by the two long rivers, is a fine clay. There is in it almost no humus, owing to the intense dry summer heat and to the lack of fuel in the neighborhood which makes the inhabitants collect all brushwood and dried bushes and to burn the droppings of their animals. The Prosopis, abundant further north, is found much less plentifully at Basrah. The strong, soaked clay, devoid of humus, bakes almost as hard as brick, and can be broken only with difficulty. The **halfah** is particularly deep rooted (its roots are in the damp subsoil, perhaps three feet down, and can be eradicated only by painful, deep digging and hand pulling. In Baghdad, the soil is lighter than it is in Basrah, **halfah** is far below ground level, irrigation water has to be raised artificially, and is consequently distributed over the surface in the usual manner. Cultivation, therefore, in Baghdad more nearly approaches that usual in dry, irrigated regions. In 'Uman, the soil is generally sand, irrigation is from the surface and weeds are few. Cultivation here thus is reduced to little more than frequent but shallow stirring, which could be described as a light forking, if forks were used in that country.

b. **Implements.** The usual cultivating implement employed in 'Uman and in the 'Iraq is a triangular spade with a straight handle. The blade is big and the handle long in Baghdad; in Basrah both are smaller: and in 'Uman, they are smaller still. Here the handle is about three feet long,

while in Baghdad it is twice that. It would seem as though, in the north of the 'Iraq, where date cultivation covers only an insignificant area in comparison with cereals, the date cultivator is still guided by cereal practice, and uses in his date garden the implement many centuries of cereal cultivation have found best. When the river rises in spring, the swirling, copper-colored water fills the great, surface canals, and flows rapidly through them out to water the young wheat and barley. A long handled spade is needed to throw out the silt from the bottom of these canals up over their high banks, and a wide blade is necessary for quickly blocking one channel and diverting the stream down another. In Basrah, on the other hand, the cultivator seems to have forgotten any connection his ancestors may have had with cereal cultivation and to have modified his spade to suit the special conditions of the Basrah date garden. In actual fact, he has two spades, one smaller than the clumsier Baghdad one, which he uses for digging, and the other, smaller still, which he uses for cleaning out the creeks. Instead of the coarse silt of Baghdad, the Basrah creeks fill with a tenacious, glutinous clay, so clinging and heavy that only a small spadeful can be dug out at each stroke. In 'Uman the water courses are all tiny, except a few at the bigger springs, where masonry channels and sluices are used. In most gardens the channels are not more than six inches wide. Consequently, and because cultivation is usually only slight, a very small spade suffices. To make this survey of date garden cultivating tools complete mention should be made of the mattock, which is used here and there throughout the date-growing regions of the old world, depending, it would seem, largely on whether or not market gardening is carried on under the palms. Insofar as the 'Iraq is concerned, it seems to be the Hasawis, or men from al-Hasa, inland from the west shore of the Iranian Gulf, who mostly use it. These men have settled widely and are often market gardeners. In most 'Iraqi date gardens, however, the mattock is not used.

Owing to the lateness of the hour, these notes may not be further prolonged. It may be noted, however, that there are interesting differences in intercropping, irrigation, pollination, thinning, pruning, and packing practices in different places, a study of which may be expected to be not unprofitable.

AFTERNOON SESSION

Dr. L. D. Bachelor, Director Citrus Experiment Station, Presiding

MR. RICHARDSON asked that I say a few words regarding the work of the University's Citrus Experiment Station. The southern branch of the College of Agriculture is composed of the Citrus Experiment Station at Riverside and the Department of Subtropical Horticulture at U. C. L. A. Both divisions are interested in the date industry. The group at Los Angeles is interested in, and keeps in close contact with the date industry as it relates to their teaching of subtropical horticulture. The group at the Citrus Experiment Station in Riverside has felt in the past that they are very largely excused from working on date problems because of the fact that you had a U. S. D. A. Date Experiment Station right here in your midst. However, in 1928-29, your palms were beset with certain diseases which demanded the attention of Dr. Fawcett and Dr. Klotz and afterwards resulted in our employing Dr. Bliss to study the pathological troubles of the date palm.

Also in 1929, at the suggestion of date growers, and Dr. Swingle, we initiated three experiments on fertilizing dates. These were not carried on over very many years before it was found that the location of each of the three plots had limitations to them, physical or otherwise, which made it necessary for us to discontinue them. During the last year we were beseeched by some of the date growers to renew our interest in the fertilizer experiments. Mr. D. Mitchell and other members of the Deglet Noor Association, including Mr. J. Arkell, and Mr. B. Cavanaugh were especially anxious for us to again take up this work. They interested us in continuing our work on fertilizer problems, in an advisory way. Through the generosity of Mr. Arkell, the work became practical as experiments were started in his garden, whereby he has actually bought the fertilizer and applied it, and we were able to participate in the work in an advisory capacity. The Deglet Noor Association has graded all of the fruit from these experimental plots. It is quite a comprehensive experiment, but I do not feel that we should claim much credit for it as an institution. If valuable information comes out of it, you will be indebted to Mr. Arkell and to the Deglet Noor Association for carrying it out and actually bearing the financial burden of this fertilizer experiment.

In addition to those activities, we were requested about 1929-30 by the Coachella Valley Water District to make a study of the consumptive use of water here in the valley as it applied not only to dates, but to grapefruit, grapes, and annual crops. During the year 1932, the Department of Irrigation, at Berkeley, stationed Mr. A. F. Pillsbury here. He made a very comprehensive study while he was here, to determine the amount of water necessary to produce these crops in the Coachella Valley. At the end of 1932, our budget was reduced, and this was one of the activities which was curtailed. During the past year, however, we have been able to take up the work again, and with the cooperation of the Division of Irrigation, U. S. Department of Agriculture, Mr. Pillsbury, who is now stationed at the Citrus Experiment Station, is again here working on that problem. The questions which have arisen refer here to the use of water and are in part due to the problem of allocating canal water if, and when, the All-American Canal is brought in and water becomes available to this valley. As you know, in the date industry as well as in other industries, there is a tremendous variation in the amount of water that is applied. If we take only the record of the use of water as it is applied at the present time, it would be very confusing for a water company to allocate water on that basis. It is with the hope that this study in irrigation will throw sufficient light upon this subject so as to be at least partially the basis of allocation of canal water, that we are continuing this work at the present time.

These are the main lines of activity of the University of California concerning the date industry. You may wonder why we are not doing more. Let me repeat some of the reasons. First, you are very well taken care of by the United States Department of Agriculture with an experiment station located here; and second, there are a great many industries that also demand the activities of the University. This past week I have been going over olive problems, other deciduous fruits and

avocado problems. The research work is conducted mainly at the Citrus Experiment Station, but only about one-half our problems have to do with citrus. Our program, of necessity, is built up on the theory that we have no foster industries. We have no foster districts. We should be as much interested in an olive trouble in Tulare County, in avocados in San Diego County, truck crops in Imperial County as industries in Los Angeles and Riverside counties. We cannot, therefore, expect to be active in research work concerning the date industry beyond our present projects unless the needs are more urgent than they appear to be at the present time.

Present Day Date Marketing Problems

By T. W. Braun

IN PREPARING this talk I thought immediately of those great problems which the industry has faced for years, due solely to our insistence upon fighting with each other:

Disastrous prices;

Destruction of consumer confidence through the lack of standard, honest grading and packaging;

The great wastes caused by our failure to control the time and place of shipments.

But I decided against any detailed review of these conditions because by this time we are all quite familiar with both the ills and the remedy.

However, I did think you might be interested in a description of those problems which would still be with us even though we had succeeded in creating a structure which coordinated the marketing of a large part of the crop.

I assure you that an analysis of such problems is more than an academic excursion. It may serve to highlight conditions which are not due solely to our competition with each other, but which are basically inherent in the major problems of moving the total of an increasing specialty crop of varying quality into consumption by a population that is relatively unfamiliar with our product.

Assuming that our main objective is to secure a profitable return per acre, what are these basic industry problems?

The largest part of our crop falls into the intermediate grades; therefore, the prices received for these grades largely determine the total dollar return for the crop.

Regardless of "what ought to be," the actual fact is that this part of the crop must be sold to average people through volume outlets. T e'r consumption slows down when the retail price exceeds 27c per pound, and 30c is about the top limit. In all of my examples, please bear in mind that I am talking about the total crop of about eight million pounds with the marketing coordinated.

Problem Number One, then, is the fact that, in my opinion, we are limited to a retail price of about 27c per pound for about 65% of our crop. This is the backbone of our gross sales, and the net dollar return will depend to a considerable degree on how efficiently we operate and bring our costs within the retail price limitation.

The net return will further depend on how we handle the two parts of the crop at each end of the intermediate grades.

The return can be materially increased if an upper bracket market is opened for the 15% of top grades, and if we can find the means of reaching this upper bracket market at a reasonable sales cost. I am now talking about one million pounds of fruit and luxury retail prices of 50c per pound and up. This is problem Number Two.

Problem Number Three is the 20% or more of the crop at the lower end of our grades. If these dates are marketed through channels which in any way conflict with our other grades, they will inevitably reduce the total price level. They must be either destroyed, or we must develop new by-products. For we are as yet far from having any markets for existing by-products which will consume from a million and a half to a million and three-quarters pounds.

Thus, you see we have a three way problem which might be likened to a broad highroad (which is our backbone of intermediate grades). This road has two branches: one leads to the top of a hill, and the other to a deep swamp.

In stating these problems, I have also told the story of the past five years of date marketing history, except that during this time these basic industry problems have been tremendously aggravated by our disorganization.

Due to the combination of depression and competitive factors, we have made very little progress in developing the upper bracket market for top grades. A large part of these grades has been combined with the intermediate grades and sold to the mass market. Also, as I have previously pointed out, cultivating the luxury pack market is a relatively costly operation. The outlets are relatively few and each sale requires an individual call and a lot of service. None of us could afford to gamble the necessary investment in this sales expense as well as in expensive packages; it has been safer to be sure the fruit moved by using it to improve the grade of our best commercial packages.

During this past period, even our broad highroad has had soft shoulders upon which we have frequently slipped into the ditch. Although our opening prices have been well within the retail price limitation and should have readily moved our intermediate grades into consumption by the average Mr. and Mrs. Consumer, as each season wore on the price level has weakened. It has been unfortunate, but no one can really be blamed. Our actions have been human and based upon human necessities. We had to have money with which to live, and as the weeks passed with continuing inventories, we have become panic stricken and dumped.

Piled upon this has been our excursion into the branch road that leads to the swamp, the sale of low grades through channels that competed directly with our better fruit.

This too has been partly due to our use of this grade as a means of meeting competition, partly due to our need for money from any and every source, and, very importantly, due to the fact that we have not developed by-products with large markets or large markets for the by-products we already have. This development, too, would have been an expensive gamble which we could not risk individually.

Granting the absolute necessity of doing the expedient thing during the past, and in the future so long as we do not have our marketing coordinated, nevertheless I am now urging

you with the greatest possible emphasis to recognize that it is vital that we each build our marketing plans so that we at least work toward a solution of the basic problems I have described. Unless we do this, we shall have no assurance that there will be bread tomorrow.

Continuing my hypothesis that we are an organized industry able to focus our attention solely upon solving our common problem and free from internal strife, let me review my formula for a solution:

1. Mass distribution of about 65% of the crop through low cost outlets. A low cost sales organization concentrated in the largest centers of population, functioning as a general coordinator of distributors but massing for educational drives upon retailers and consumers. Packages should be cheap but attractive through fine design, and adaptable to machine filling and wrapping. The whole plan fits into a retail price of about 27c per pound and permits profits within this price limitation. This is the backbone and lifeblood of the business and is the one part of our marketing which is already well established.

2. A special service organization to cultivate the specialty outlets for luxury packs to retail at 50c per pound and up.

3. Experiments with new by-products and subsidizing experiments in expanding markets for existing by-products as a means of eventual revenue from the low grades. But under no circumstances would such grades be permitted to conflict with the major part of our crop.

Since I have asked you to let me be hypothetical, I will go on to the next step and make some assumptions about the effect of such an industry operation, when completed, upon our objective of securing a profitable return per acre.

Let us take one hundred pounds as an example.

Sixty-five pounds are to be sold at 27c per pound retail. Allowing for liberal discounts, the net price to us at destination would be 17c per pound, which is

65x17 or $11.05 as our backbone.

We will sell fifteen pounds in our specialty packs at 50c retail which, after discounts, will net us at destination 27c per pound, which is

15x27 or $4.05.

If we destroyed the low grade balance of 20%, we would then be grossing $15.10 for our one hundred delivered pounds, an average of 15.1c per pound. From this figure, I can give you the following costs as deductions. These costs are based upon experience.

Transportation and warehousing covering the United States will average 2c per pound. Sales expense will be not more than 1½c per pound. This includes salaries; salesmen's expenses; office expense, including all sales accounting such as billing, etc., telephone and telegraph. The total of the above mentioned expenses is 3½c per pound, which is

80 pounds sold x 3½c or $2.80.

Deducting $2.80 from $15.10 gives us a net at the plant door of $12.30, which is 15.3c per pound for the eighty pounds sold, or 12.3c per pound average for the total of one hundred delivered pounds.

In my opinion, we should spend at least one-half cent per pound for advertising, dealer service work and sampling, which would then make our return at the plant door an average of 11.8c per pound for the hundred pounds.

The packing expenses of each plant would vary, depending upon facilities and volume handled; but, based upon the experience of the Association for three years, it would be safe to say that total plant costs should not be over .032c per pound. This includes packaging, grading, overhead, interest on borrowed money, etc.

Deducting this cost from the 11.8c, there would remain a net for the grower of 8.6c per pound average for the one hundred pounds delivered.

Eventually, the 20% of low grades should be marketed successfully in by-products. If we assumed that only a net of 1c were secured for the grower from this source, it would increase his total revenue to an average of 8.8c for one hundred delivered pounds.

Considering our present struggles to produce an average of one-half as good, the above figures may seem Utopian. And some of you may feel that they are far short of what should be secured. Frankly, I feel that they represent a really practical picture of the return that could be made with proper organization and several years of very hard work.

I don't think the return could be much increased, and if it were larger, I believe it would be extremely dangerous. It would encourage an increase in production at a faster rate than the market could be developed, with resulting glutted markets and another slide in the ditch.

In the foregoing, I have attempted to sketch our marketing problem with rough strokes on a large canvas. There are many smaller problems which we must solve.

Neither imported nor California dates are well established in the national diet. Dates are known to, and used by, a large part of the population, but research has shown that consumption is primarily confined to a holiday and cooking use.

To change this condition, even with the fine quality of our California date, is quite a difficult job because we are apparently up against several factors of importance:

1. Dates apparently do not have that "come back for more taste" which many foods have and which is necessary to establish a repeat habit. Nuts are a good example of the special taste quality I am trying to describe.

2. The industry has been unable to afford the advertising which is necessary to establish the healthful qualities of dates, and an appeal to health is another basic way to establish a habit.

3. A third way of increasing consumption of a food product is by relating it to some basic function or other food type which is already well established in the daily life of the consuming family.

When the housewife starts to plan her daily shopping, she does not first think of specific foods. She thinks in terms of meals—what shall I have for breakfast, or dinner, or for the bridge luncheon? For instance, orange juice is related to breakfast, which is a daily occasion for which she plans. Another illustration is corned beef and cabbage. She first thinks of dinner. Then decides upon corned beef, and cabbage follows automatically. Far less cabbage would be consumed if it were not for this relationship.

Before dates can become a part of the food habits of large numbers of people, they, too, must be so related to meals, other foods and special occasions. As an industry, we have been somewhat confused in working out this problem. This is due partly to the fact that we have been thinking in terms of our product instead of in terms of consumer habits, and partly due to the fact that dates may be related to so many things that we have not decided upon the few best bets and concentrated our fire.

As a confection, dates may be related to candy and sold as a healthful sweet for children and grownups.

As a grocery item, dates may be included in cookies and puddings, etc., and related to the dessert course of meals.

As a fresh fruit item, we again have a fundamental health appeal, "a fresh fruit when other fresh fruits are scarce." When Mrs. Housewife

thinks of winter salads and fruit cups, she should automatically think of fresh dates as a delicious, healthful ingredient.

The solution to these problems lies in advertising and the proper sales promotion concentrated upon these few basic habits.

Also involved in these problems is the question of distribution channels and retail outlets. Fortunately, the problems of establishing dates in the consumer routine, according to the several classifications mentioned, also ties in prefectly with the broader picture of distribution which I sketched earlier in this talk.

Dates as a confection, a healthful sweet for children and for festive occasions, offer us the big idea for our luxury packs of top grades to be sold through specialty outlets. The ordinary jobber or broker is not geared to the educational selling which is necessary to develop this market. This sales job should be done through direct contact by experienced merchandising men.

In reaching mass markets with our intermediate grades, we must use mass, low cost distribution. Available to us are the broker, the wholesaler, the chain store, and the wagon distributor. All of them have their place, but some are far more important than others.

The chain stores really offer the perfect example of what we are looking for. They have eliminated all excess in-between expense and give us the shortest road to the consumer. Because their buying and merchandising policies are concentrated in the hands of a relatively few men, we can secure distribution through a large number of outlets with only a few sales contacts. This, in turn, means that we can have a small, economical sales force. The chains represent organized, efficient mass distribution, which is the counterpart of organized selling by a farmer cooperative.

The California Date Growers Association sells some 40 per cent of its crop to the food chains. Through them, we have been able to secure uniform merchandising drives throughout the country at a relatively small advertising and promotion expense.

The small grower can never sell the chains nationally with continued success because the chains require a large, uniform dependable source of supply. As an example, the A & P recently testified at a hearing before a California legislative committee that to place one crate of lettuce in each of their 16,000 retail units required fifty carloads.

The regular produce wholesaler is the cheapest route to distribution in the independent stores and will always be important to us. Unfortunately, most produce wholesalers are not good merchandisers of a specialty product such as ours. They are used to dealing with staples in carlot quantities and depending upon speculative price advantages to secure their trade. When and if these dealers recognize the necessity of following through to their retailer customers with constructive merchandising help, their value to us will be increased accordingly.

The store-door wagon distributor does understand merchandising and is a fine distributor for us because of the educational work which he does and because he frequently places a stock of dates in the retail store at his own risk. In effect, such distributors hire a certain shelf space and as they replenish the sold stock, they collect from the retailer. The chief drawback to this type of distribution is its high cost.

Among the many other problems that I could talk about, I will select one more for brief discussion. That is the problem of marketing in an orderly manner over a number of months instead of trying to force our crop on the market during a brief period.

I believe that the date marketing season may easily extend from September 1st to May 31st. The Association has intentionally carried over an average of 500,000 pounds for the past two years. By so doing, we are able to get in an additional 45 days of date consumption in the early fall before the new crop reaches the market. This is consumption which we would not get otherwise and, by removing pressure from the other months, it helps to maintain the price level.

Such orderly marketing requires adequate finances with which to finance the inventory as well as make advance payments to growers. Fortunately, such financing is available through bank credit.

Some of my talk may have seemed to be propaganda for the Association. I assure you that I tried not to inject propaganda, but have cited the Association solely as an example.

Honestly, however, as long as I am connected with the date industry I shall never give up hoping that we will eventually work out some cooperative means for working together upon our common problems.

Experiments In Hydrating Dry Deglet Noor Dates

By Wm. R. Barger, Associate Physiologist, Division of Fruit and Vegetable Crops and Diseases

Introduction

USUALLY a considerable part of the Deglet Noor date crop is too dry to be sold as either fresh or cured fruit. In past years about 30 per cent of the fruit has had to be graded as "dry." With an annual production of 5,000,000 pounds and with the steady increase anticipated from the large acreage coming into bearing, the utilization of this dry fruit becomes an important problem.

An increasing tonnage of dry dates is utilized in the manufacture of such by-products as date crumbles and date flakes but most of the dry dates are processed and marketed as whole fruit after being softened and moistened. This processing or hydration of the fruit is accomplished at the present time by holding the dry dates in a hot, humid room until they become soft. Usually live steam is turned into the room intermittently to increase the humidity. This also raises the temperature to about 130° F. which is as high as desired. This process is continued for 12 to 36 hours, depending on the initial dryness of the dates and the amount of rag or fiber which they contain. Little is known of the chemical effect of heat and humidity on dry fruit during this process. However, it is known that during steam hydration the dates gain weight, become soft, and usually turn dark and sirupy.

This paper gives the results of experiments in which dry Deglet Noor dates were hydrated by a steam process and also in atmospheres at temperatures of about 100°, 80° and 34° F. with high and low relative humidity to determine the effect of

these conditions on the color, texture and sugar of the fruit.

Experimental Methods

The dry dates to be hydrated by the steam process were enclosed in net bags and placed with fruit receiving commercial steam treatment. Dates to be hydrated at lower temperatures were held in constant temperature rooms in large glass jars in which the relative humidity could be controlled. The high humidity (98 per cent) was obtained by keeping water in the bottom of the jars. Relative humidities of 86, 75 and 65 per cent were obtained in other jars by similarly using suitable concentrations of sulphuric acid and water. At intervals the dates were weighed and inspected for color and presence of sirup, and mold. Sugar analyses were made at the beginning and end of the tests.

Effect of Hydration on Weight of Fruit

In studying steam hydration a temperature of 120° to 130° F. was maintained in the room. The dry Deglet Noor dates used had an original moisture content of about 15 per cent. They gained 3 per cent in weight in 2 hours treatment and made a total gain in weight of 15 per cent during 16 hours treatment. Analysis showed that the gain in weight was due to a gain in moisture content of the flesh. In a parallel test in air at 160° with 98 per cent relative humidity the fruit gained 6 per cent in weight in 16 hours.

The effect of lower temperatures with different percentages of relative humidity on the weight of dry dates in other experiments is shown in table 1.

Table 1

Gain in weight of dry Deglet Noor dates* when held in air at temperatures of 100° and 80° F. and different percentages of relative humidity.

Air temperature ° F.	Relative humidity Percent	Total gain in wt. of fruit 2 days Percent	5 days Percent	8 days Percent	11 days Percent
100	98	5.3	13.0	18.7	
100	86	1.6	3.9	5.8	
100	75	1.2	2.8	4.3	5.6
100	65			.3	
80	98	3.2	7.7	11.1	
80	86	1.0	1.7	2.1	
80	75	.7	1.4	2.1	3.2

*Fruit contained 15 per cent moisture at start of experiments.

As shown in table 1 the most rapid absorption of moisture was at the highest temperature and with the highest humidity.

Both humidity and temperature affected the rate at which these dry dates absorbed moisture. Fruit exposed to a fog of steam gained weight much faster than fruit held in air having a high relative humidity. Fruit held in a relative humidity of 98 per cent gained weight about three times as fast as in 86 per cent relative humidity. At a temperature of 100° F. moisture was absorbed about twice as fast as at 80°.

Effect of Hydration on Softening of Fruit

Softening of the flesh of dates progressed as moisture was absorbed but was not dependent entirely upon the added moisture. Dates held at temperatures of 100° F. and higher became soft after absorbing about 7 per cent moisture, whereas those held at 80° required the addition of 10 per cent moisture before they became soft. It will be shown later that at temperatures of 100° and higher, invert sugar was increased and it is well known that date flesh containing this type of sugar is softer than flesh containing mostly cane sugar.

Effect of Hydration on Sirup Formation

Sirup formed on the skin of the fruit that was steam hydrated. On the lot held in air at 100° F. with 98 per cent relative humidity, sirup did not form until after about 15 per cent moisture had been absorbed.

Effect of Hydration on Color of Fruit

The dates turned dark in color during the steam hydration process but did not darken much during processing in air at temperatures of 100° F. and lower until after an excessive amount of moisture had been absorbed. The dates could be classed as cured fruit after 2 days at 100°, 98 per cent relative humidity, 4 to 5 days at 80°, 98 per cent relative humidity, or 8 to 11 days at 100°, 75 to 86 per cent relative humidity. Further hydration at these temperatures to produce fruit as soft as a perishable grade resulted in a high percentage of moldy and dark-colored fruit.

Effect of Hydration on Mold Development

Dates hydrated in a room at 100° F. and 98 per cent relative humidity until the moisture content was about 25 per cent did not mold during the hydration process nor during subsequent storage for several weeks at room temperature. The fruit was held in glass jars to keep it from drying out after being hydrated. When the dates were hydrated to a 30 per cent moisture content they molded readily under these same conditions.

Effect of Hydration on Sugar Content of Fruit

The various processing temperatures and humidities used affected the proportion of invert sugar and cane sugar in the fruit without materially changing the amount of total sugar. It is well known that there is a considerable variation in the total sugar of dates of the same variety and grade. The total sugar of the dates used in these experiments before hydration was 69.8 per cent of the weight of the moisture-free flesh in lot 1 and 87.3 per cent in lot 2. Whenever an increase in invert sugar occurred as a result of hydration it was accompanied by a decrease in cane sugar. The sugar analyses at the beginning and end of the various tests are given in table 2, together with the percentage of the total sugar found to be invert sugar.

During 16 hours of steam hydration, invert sugar increased from 38.4 per cent of the total sugar to 71.2 per cent and during 8 days in air at 100° F. and 98 per cent relative humidity, the invert sugar in lot 1 changed from 38.4 per cent of the total sugar to 80.5 per cent, and in lot 2 from 24.1 per cent to nearly

Table 2

Effect of temperature and humidity on sugar content of dry Deglet Noor dates during hydration treatment

Lot No.	Air temperature ° F.	Relative humidity Percent	Time	Moisture in sample Pct.	Sugar as percentage of dry matter: Invert sugar Pct.	Cane sugar Pct.	Total sugar Pct.	Invert sugar as Pct. of total sugar Pct.
1	Start			17.0	26.8	43.0	69.8	38.4
1	120-130	fog	16 hrs.	27.0	53.3	21.5	74.8	71.2
1	100	98	8 days	30.4	61.1	14.8	75.9	80.5
1	100	75	8 days	19.5	35.6	44.8	80.4	44.3
1	100	65	8 days	17.0	33.3	42.2	75.5	44.1
1	80	98	8 days	20.0	26.8	42.9	69.7	38.4
1	80	75	8 days	18.4	28.1	47.5	75.6	37.2
2	Start			13.5	21.0	66.3	87.3	24.1
2	103	98	10 days	28.3	65.4	7.8	73.2	89.4
2	103	86	12 days	19.4	39.3	28.7	68.0	57.8
2	103	1*	12 days	14.2	26.7	50.9	77.6	34.4
2	80	98	12 days	25.2	30.0	44.3	74.3	40.4

*Moisture - proof container.

90 per cent. Invert sugar doubled in amount during 12 days at 103° and 86 per cent relative humidity, while comparatively little inversion occurred at this temperature when a relative humidity of 75 per cent was used or when the fruit was held in moisture-proof containers to prevent absorption of moisture. At a temperature of 80° very little inversion occurred even in high humidity.

Hydration was also accomplished in cold storage. Dry Deglet Noor dates containing about 14 per cent moisture were held at a temperature of 34° F. in 98, 86, and 75 per cent relative humidity. The gain in weight of the fruit during a storage period of 15 weeks is shown in table 3.

The dates held in high humidity absorbed moisture at the rate of about 1.5 per cent a week, whereas the lot held in 86 per cent relative humidity gained less than half this amount.

After gaining 7 to 10 per cent moisture the dates had the consistency of cured fruit and more than 15 per cent moisture had to be added before they became soft. The softening of dry dates in cold storage required the absorption of more moisture than was necessary at higher temperatures and is probably due to the fact that little inversion of sugar occurred during cold storage. Although some of the dates absorbed nearly 19 per cent moisture in storage they did not become dark in color nor sirupy and did not mold until after removal from storage.

Inversion of cane sugar was greatly retarded but was not stopped at a temperature of 34° F. As shown in table 4, the invert sugar amounted to 24.1 per cent of the total sugar when the dates were placed in storage, and increased in 15 weeks to only 37.7 per cent in the lot that absorbed 8 per cent moisture and to 43.3 per cent in the lot that absorbed nearly 19 per cent moisture. Practically no inversion occurred during this time in the lot held in 75 per cent relative humidity and which absorbed only about 5 per cent moisture.

Table 3.

Percentage of gain in weight of dry Deglet Noor dates in cold storage*

Air temperature ° F.	Relative humidity Percent	Total gain in weight of fruit 3 weeks Percent	5 weeks Percent	7 weeks Percent	15 weeks Percent
34	98	4.6	7.3	10.6	18.9
34	86	1.6	3.0	4.3	7.9
34	75	1.2	2.1	3.2	5.4

*Fruit contained 14 percent moisture at start of experiment.

Table 4.

Effect of temperature and humidity on sugar content of dry Deglet Noor dates during cold storage

Storage temperature ° F.	Relative humidity Percent	Moisture in sample Percent	Sugar as Pct. of dry matter: Invert sugar Percent	Cane sugar Percent	Total sugar Percent	Invert sugar as Pct. of total sugar Percent
Start		13.5	21.0	66.3	87.3	24.1
*34	98	29.0	36.5	47.8	84.3	43.3
*34	86	22.5	32.8	54.2	87.0	37.7
*34	75	20.0	22.8	60.2	83.0	27.4

*Dates analyzed after 15 weeks in storage.

Discussion

These experiments show that some major changes occur in dry Deglet Noor dates during hydration.

The inversion of cane sugar was affected by both temperature and humidity. It is believed that this is the first report that inversion of cane sugar in dates is influenced by the moisture content of the fruit. At each of the holding temperatures used, inversion was accelerated by the absorption of moisture by the fruit, being most rapid at high temperature and high humidity and least at 34° F. and low humidity. Within the range of normal room temperature inversion was much less at 80° than at 100°, which is in accord with published data on non-dry Deglet Noor dates. Although the relation of time to rate of inversion is not readily apparent from the data, tables 2 and 4 show that steam hydration or a holding temperature of about 100° with high humidity for 8 to 10 days changed these cane sugar dates to fruit in which invert sugar predominates. At holding temperatures of both 80° and 34° inversion was slow enough to allow the absorption of sufficient moisture to soften the fruit before the invert sugar increased to as much as half of the total sugar.

Conclusions

The primary purpose of these tests was to study the changes taking place during hydration of dry dates. The control of color and sirup formation obtained by using low temperature is probably impracticable commercially because of the long time needed to soften the fruit. However, the data suggest the possibility of combining hydration and storage for the part of the crop that is not marketed immediately after harvest; also the possibility of starting hydration at low temperature in order to shorten the time necessary to finish the process in the steam room and thus expose the dates for the shortest possible time to temperatures that cause undesirable darkening of color and formation of sirup.

Progress Report On Preliminary Cover Crop Trials

By Frank A. Thackery and George H. Leach, U. S. D. A. Date Experiment Station Indio, California

IN COMMON with other orchard crops, the problem of organic matter is one of importance in date production. So far there is little available data covering the production of cover crops and their utilization in date orchards. As a preliminary step in planning comprehensive cover crop trials a series of small plantings both in a date orchard and in the open field have been made at the date experiment station. Such results as have been obtained from these first plantings cannot of course be used as a basis for orchard planting recommendations, there is always danger in jumping to conclusions from limited data and observations. The loss of seed caused by birds in these small plantings was considerable and reduced the yields in a measurable degree in some varieties. It is only from large scale plantings replicated several times and carried on over a period of years that reliable recommendations can be made. These observations are given in the nature of a progress report and to stimulate discussion and exchange of growers' experience.

Only the results of the first six months work have been summarized, time not having permitted the preparing of the data for the second six months' period. The results of crops grown in this latter period will doubtless prove of special interest to many growers as they concern crops grown during the fall and early winter months. The next progress report will cover the full year's results.

The following is a list of the cover crop varieties included in tests during the past year:

Melilotus alba
Melilotus indica
Hubam clover
Cow peas
Soy beans
Austrian winter peas
Tepary bean
Purple vetch
Hairy vetch
Sesbania
Korean lespedeza
Lespedeza striata
Crotalaria stricta
Crotalaria spectablis
Buckwheat
Comomn rye
Eastern rye
Rosen rye
Soudan grass
German millet
Yellow mustard
Mustard trieste
Wild black mustard

On the first day of each month for a year beginning with February, 1935, two plantings of each of these twenty-three varieties were made. These plantings consisted of two rows of each variety twenty-five feet in length, the two rows being approximately eight inches apart. The ground area covered by a single one of these plantings was 54.6 square feet, or 80.4 part of an acre.

Of the two plantings made of each variety on the first of the month one was in a date garden of mature palms of fifteen to twenty-five years of age where there was much shade and plant competition. The other was made in the open field where there was practically no plant competition and no shade. In both plantings the ground was irrigated and cultivated in the same manner.

In the list of varieties used there are fourteen legumes and nine non-legumes. The following tabulation shows in brief manner partial results of these tests for the six month period beginning with February, 1935. Only the five highest yielding varieties in both orchard and field plantings of the twenty-three under trial are shown. The high yields are shown both in green and dry weight. In all cases the cover crop was harvested when it was apparent that it had reached its maximum growth. Following cutting immediately the green weight was recorded. The sample of each variety was carefully sacked until it was thoroughly dried when it was again weighed for the dry weight.

The Tepary bean thus far appears to be one of the most promising. It will be interesting to know that this bean was domesticated by the Papago Indians of southern Arizona. Although it provides a vigorous and luxurious top, the bean is very small. A record of the percentage of germination and cultural operations has been kept. Fresh tepary bean seed was not available. Seed on hand for several years was used, consequently the percentage of germination was much lower than it would ordinarily be, nevertheless, this cover crop has registered amongst the five highest yields.

It will be noted in this table that nine out of the twenty-three cover crops have registered in the five highest yields of either the orchard or field plantings. One of these nine high yielding crops, Soudan grass, registers four times. In this connection it will be interesting to note that immediately following the harvesting of Soudan grass, it provides a vigorous, luxuriant growth from the roots. Just how many times it would come back after being harvested is of course not known, but at the station it made an excellent growth after the third and final cutting in a single season.

These preliminary tests are being used as a basis for much larger plots in both orchard and open field conditions. From such plantings carefully observed over a period of several years it is hoped to gain reliable data for the use of growers concerning best cover crops for date orchards, having in mind economy in costs and handling as well as highest tonnage.

It is hoped that growers will visit these plantings often, and will also report results of their own cover crop trials to the end that available knowledge on this problem may be as complete as possible.

Five Highest Yielding Varieties for Plantings Made in February, March, April, May, June, and July

Cover Crop Variety		Field Planting Green Pounds	Field Planting Dry Pounds	Orchard Planting Green Pounds	Orchard Planting Dry Pounds
Sesbania	May	100.4	40.12		
Soudan grass	May	77.9	28.2	51.3	13.0
Sesbania	June	76.13	27.15		
Soudan grass	July	76.7	25.10		
Tepary bean	June	65.1			
Soudan grass	June		24.10	112.2	36.1
Tepary bean	July			51.3	13.1
Soudan grass	April			37.8	12.5
Soy bean	June			29.8	9.1

Rapid Determination of Sugar Contents of Dates

By R. H. Postlethwaite, M. I. E. E.

FOLLOWING is a description of method developed by the writer for the rapid determination of the sugar content of dates for use in a packing house not equipped with a complete laboratory operated by a chemist.

In non-mathematical language it is based on the fact that the addition of the percentage amount of the various elements contained in the edible portion of a date each multiplied by its specific gravity must equal the specific gravity of the whole.

The elements may be considered under three heads, namely:

Sugar with a known specific gravity of - - - - - - 1.61

Water with a known specific gravity of - - - - - - 1.00

Marc with an assumed specific gravity of - - - - - - 0.5

Marc consists of cellulose, protein, crude fibre and other elements. The percentage of marc, however, is small and a slight error in its specific gravity will have little or no effect on the final result.

Equipment Required. Scale balance graduated to one-tenth gram, small electric heater, 500 ml. flask, graduated drip trap, reflux condenser and quart of Xylene, the above is for the moisture determination by means of the Xylene method which is very simple and can be finished in less than 30 minutes.

Weigh out 25 grams of representative date meat cut into small pieces and place in flask which contains enough Xylene to amply cover the date meat.

Attach the flask to reflux condenser and drip trap graduated to cubic centimeter, place flask on heater and connect condenser to water supply, boil for 20 minutes and read cubic centimeters of water collected in drip trap which multiplied by 4 will give the percentage of moisture contained in the date meat.

Specific gravity determination requires one hydrometer and three or more jars containing sugar solutions of specific gravities of 1.150 to 1.350 checked by hydrometer.

The whole of the above equipment can be purchased for approximately $35.00.

For specific gravity determination split representative dates, take out pit and place in sugar solution, the specific gravity cna be taken as follows: If the date floats in 1.300 and sinks in 1.250 it may be taken as 1.275.

The known factors for the sugar determination are as follows:

w = weight of edible portion including moisture = 100%

a = specific gravity of the edible portion of date

b = percentable of water in ditto the specific gravity of which = 1.00

s = percentage of sugar in ditto the specific gravity of which = 1.61

m = marc (100-b-s) assumed specific gravity = 0.50

then $1.61\ s + \frac{b + 100 - b - s}{2} = 100a$

Solving $s = (100a - b - 50)\ 0.9$

Example Suppose a = 1.300 and b = 30 then

s% = (130-15-50) 0.9

= (130-65) 0.9 = 58.5% green weight

or $\frac{58.5 \times 100}{70} = 83.5\%$ to dry weight.

The number of dates per pound can readily be arrived at by weighing 5 representative dates, then 2268 divided by the weight in grams of the 5 represents the number per pound.

All the above is to give a simple and rapid method to evaluate fruit as it is delivered to the packing house. This means more than just the appearance and moisture content but also the degree of maturity of which the sugar content is a vital factor.

The writer will be glad to more fully explain the method to those interested.