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Seventh Annual Date Growers Institute

Afternoon Session, Friday, April 4, 1930

Dr. H. J. Webber, Professor of Sub-Tropical Horticulture, Citrus Experiment Station, Riverside, California, Presiding

Dr. Webber: Mr. Chairman, ladies and gentlemen; I thought that Mr. Postlethwaite, your chairman, was certainly going to make an address and therefore I would not prepare one myself, because I was sure that he had.

I am delighted, friends, to be here with you. It gives me great pleasure to have the privilege of presiding over this meeting once more. I have the feeling that I had a little bit to do with the starting of this institute seven years ago this spring. I think that it was partially due to my efforts that the first committee, of which Dr. Faries was chairman, organized this meeting, and this is the seventh successful date institute. In starting a new industry it requires a lot of enthusiasm to keep things going. It is by enthusiasm that the success of the industry is kept going.

The word co-operation is one of the main things that figured in our first meeting — the necessity of co-operation in the industry. The years that have passed have served to emphasize the necessity of co-operation. I think your institute here is a great thing. It comes to you as being a successful effort in co-operation.

I was interested to know what Mr. Postlethwaite said about these reports going to all countries of the world and forming part of the standard literature of the date industry. I recall that this was one of the things that was stressed as the main reasons of having an institute of this kind—to bring together the thoughts and ideas of men in the industry. I recall that the Avocado Association was at that time new and that they were building up their literature. Now, if you look over the avocado industry the first literature you turn to are the reports of their institute. If you turn to the literature of the date industry you will realize that their reports are becoming more and more important.

The station I have represented for the last fifteen years, the Citrus Experiment Station, is becoming greatly interested in dates. The government is becoming interested in dates and it is fitting that the University and the State should become interested, because the industry is apparently here to stay and its being here and staying depends upon your enthusiasm. You cannot maintain this enthusiasm unless you come together —unless you realize that the way to bubble over with enthusiasm is by coming together. This is the place for you to show your enthusiasm. I hope, however, that the speakers of the day will stick pretty close to the truth. It is pretty hard to stick to the truth when it is so big, but we ask our speakers to be a little cautious about that.

I have said the few words of introduction I think necessary, and we will now go on with the program.

Morning Session, Saturday, April 5, 1930

Col. Dale Bumstead, Phoenix, Arizona, Presiding

Col. Bumstead: Ladies and gentlemen; it gives me very great pleasure to be here. It is a very great honor to stand for even a few moments in the tracks of the gentleman who presided yesterday afternoon and the other one who will follow me today.

In looking at this group of intelligent people I ask myself just why we are here. I have given it quite a bit of thought. We are not here, I think, solely because we hope to improve our financial condition. Anything that we may do in that direction is desirable, because anything that increases the wealth of the country and raises the standard of living is of great benefit to all of the people, and that is very much to be desired. But that is not the entire reason. In a way we are here with the idea of learning from the scientists who speak on some special subject connected with the industry, ways and means and methods for producing more and better palms and fruit. Back of that lies the hope that in this way we may produce better people, a higher standard of living and better citizens.

I believe agriculture which has definitely lagged behind other industries is about to come into its own. There are good reasons why agriculture has lagged behind and why we may hope now it may take its place with other industries.

For a long time each farmer has had to depend upon his own efforts and own initiative in developing his farm.. There was an interval of nearly 2,000 years since the farmer had plenty of power for the development of agriculture. In talking with Dr. Webber, he agreed with me that the last period when agriculture reached a high state of development was 2,000 years ago—when the Romans, with no more worlds to conquer, and with an unlimited number of slaves, went into agriculture. Many of the developments which we are just taking hold of with a great deal of interest and which apparently to us are new, we find being used at about the time of the Emperer Tiberius. The works of Junius Columella remain today perhaps the greatest book on agriculture.

We have now more slaves than they — by the development of machinery and unlimited electrical power, we have at our command facilities undreamed of. I am sure that with the intelligent use of this power we can at least go as far as the Romans who did so much in that distant time.

I hope we shall go on, and continue to grow happier and better palms and happier and better people.

Seventh Annual Date Growers Institute

Afternoon Session, Saturday, April 5, 1930

Dr. L. D. Batchelor, Director of Citrus Experiment Station, Riverside, Presiding

Dr. Batchelor: Mr. Postlethwaite (chairman), ladies and gentlemen; I am sure it is a pleasure to meet here with the date growers and discuss their problems and share with them in the perplexities which surround this industry. Before introducing the next speaker I must express my appreciation as a representative of the Citrus Experiment Station, an appreciation for the confidence which the people in this valley have shown in that institution, not only in conferring with us concerning problems which are before the date industry and inducing our assistance in working on those problems, but we especially appreciate the patience which the men of the date industry have shown in the methods which must necessarily prevail in the conducting of these research problems. I think I might almost apologize to you in regard to the name of the institution I represent. It was developed along the present line of its organization during 1913 and 1914, and its organization was primarily due to the efficiency of the support given by the citrus industry. It was more or less in recognition of this that the institution was named the "Citrus Experiment Station." There has been a growing appreciation and confidence shown on the part of the people in this institution. This has been exemplified in the increased demands upon the institution to serve the agricultural needs of Southern California, and also by the increased support of the institution by the state. At the present time the Citrus Experiment Station is between four and five times as large as it was 17 years ago. Measuring the size of the institution by the number of men engaged in research activity, measuring it by the amount of appropriation, we have grown between four and five fold in the past 17 years. This is largely due to the great appreciation and confidence shown in the past by the people in the southern part of the state for this institution.

I suppose that at the present time somewhat less than one-half of the activities are devoted to the citrus crops. We are working on problems which have to do with melons, alfalfa, apricots, dates and walnuts, besides oranges and lemons; so that without going into the matter very carefully I would judge that slightly less than 50 per cent of our activities at the present time are actually devoted to either orange or lemon crops. We hope under the present organization of the work in this institution that it may be looked upon as being of the greatest assistance to agriculture in Southern California; that it may be looked upon with as great confidence as are the laboratories which are devoted to scientific research which have been established by some of the large commercial organizations in this country.

We hope that the agricultural industry of Southern California may look upon the agricultural research work of the United States Department of Agriculture, and the University of California, in some measure as the Union Carbide Co. and other large companies look upon their research laboratories.

In going into greater detail of the date industry insofar as the work we have undertaken on this problem, Dr. Klotz reported this morning, and Dr. Haas will report this afternoon. I should like to mention briefly some of the work Dr. Fawcett is doing, upon which he is engaged at the present time. Dr. Fawcett has worked on some pathological problems of dates here in the Coachella Valley and this year he is continuing that work, studying in Algeria, Morocco, Tunise—going back to the area from which some of our date material had been derived. He is studying diseases and their treatments which seem to be most affective in controlling same. We hope that the knowledge which he will gain will be of direct value to you here engaged in the industry in this pioneer country.

I shall not speak further about our activities at the present time.

Time When Embryo Buds Form

By Dr. W. R. Faries, Arabah Farms, Coachella, California

I HAVE been asked to tell when the embryo fruit buds begin to develop in the date palm.

I will first state my answer to the question, and then try to develop my reason for, and the evidence of, my belief. I will also try to do so in such a way that anyone of you can for yourselves prove or disprove my statements.

I am confident that the date palm begins to develop the fruit buds for the following year as soon as the fruit for the present year is fully completed, and there remains only the changing of starches into sugar in the date itself. Then the life of the palm is free to begin a new undertaking.

In November, 1929, desiring to know if it were likely that a soluble fertilizer, then applied, would stimuate the development of 1930 buds, I dissected a male palm, that had the habit of blooming late, and found the more advanced buds to be but an inch long.

Desiring to know more about the buds of the date palm, we used a group of twenty-year-old palms that had been pulled up about January 1, 1930, and left lying near the roadside. For the last few years these palms had received only what water came to them from a cotton field.

January 24th, 1930, Dean John H. Reisner of Nanking Agricultural College came, and we prepared three feet of the upper part of a large female palm by cutting off closely the fruit stems and the leaves. The palms were alive and tissues in fine condition. We cut through the stem to get at the base of the leaves and fibre. The men from the U. S. Department of Agriculture at Indio came to assist in the dissection and to take photographs and to preserve the specimens. Each leaf with its fibre forms a complete circle or tube and encloses every other leaf above it. The fruit bud springs from the base of its leaf at the junction with the trunk of the palm. When the leaf is cut carefully away from the fibrous trunk of the palm, the fruit stem or the undeveloped bud comes with it.

In our dissection, proceeding up the trunk of the palm, first came the old fruit stems of 1929 attached to their leaves. Then came a series of leaves with undeveloped buds. These were either a bit of dried tissue or a little triangular flap. These leaves were the summer and autumn leaves of 1929. Next we came to crown leaves that were not fully developed and the fibre was still a delicate sheet of pale ivory tissue, and the little buds were delicate spathes an inch or two long, getting longer and longer as we went towards the center of the terminal bud. The greatest length of a bud was five inches. This was the upper bud or the next one to it. If you will watch the spathes push up in the spring you will see that it is the inner or upper bud or the next one to it that appears first. Then the outer ones develop in succession outwardly.

It is the buds that are the nearest the central terminal bud that are the most active. These neglected palms produced eight or ten fruit buds in a year. We knew that well cared for palms will develop fourteen or sixteen fruit buds in a season.

After we had dissected away the leaves with the embryo fruiting buds of 1930 we came to a series of embryo leaves with minute embryo buds but every leaf had its embryo scale-like bud.

These embryo leaves were divided by a little pink tissue or line, leaf from leaf, stem from stem, and pinnae from pinnae. This pink tissue dries up and appears on the new leaves as thin brown sheets or shreds or scales and powder.

We dissected three large palms. In one we included the years 1927-28-29-30. And in all three we believe the 1931 leaves were represented by a small cone of embryonic leaves about two inches high.

The Phyllotaxy of the date palm seems to be thirteen leaves to complete the circle. It seemed that in these three palms there were 26 leaves developed in a year. Counting each lot of leaves with developed buds, which we know appear in early spring, and the leaves with undeveloped buds up to the next series of leaves with developed buds, we had 26 leaves for a year. Applying this to the embryo leaflet in the terminal bud of the palm we had still a little cone of embryo leaves almost too delicate to handle which we labelled 1931 leaves.

Eager to find if this lot of leaves that did not develop buds belonged to one year, this February I went to my first palm that was showing spathes. Marking each leaf as we counted we found eleven spathes and 22 without spathes, making 33 leaves for the year. Each year there is a series of leaves that do not develop fruit buds.

Young palms that have not fruited, often blossom in late summer or autumn. This is an inndication that they can develop fruit buds and the following spring will blossom.

One spring or early summer we cut off all the shoots from a male palm. That autumn it put out an abundance of blossoms.

The question arises, can we make these lazy leaves produce fruit or must we grow more leaves?

In my reading lately I came across a report of an agricultural investigator on his experiments on apples. He said that forty leaves were required to produce a single apple. After the apple was completely formed, the leaves formed the buds for the next year's fruit. If the fruit was not thinned the leaves did not form enough buds for a full crop the next year. If the fruit was thinned properly, the leaves made many fruit buds for the next year.

I believe this applies directly to our date palm.

Recent Observations of Date Culture In Iraq

By Roy W. Nixon, Associate Horticulturist, Bureau of Plant Industry, U. S. Experiment Station, Indio, Calif.

IRAQ, better known as Mesopotamia, is the oldest and most important date growing country in the world. The recent excavations by the British Museum and the University of Pennsylvania on the site of ancient Ur have confirmed the long known antiquiety of date culture, the origin of which antedates the first written records. The earliest cuneiform tablets, dating to about 3500 B. C., refer to it as an established fact, and with them have been found representations of date palms on burnt clay.

The importance of date culture in this region is shown by the exports. According to reports of the Iraq Customs the total exports for the financial year 1927-28 were 148,232 tons, or approximately 300,000,000 pounds. There is no competitor in bulk trade for world markets. Algeria and Tunis have some export of fancy dates, but their total at present is less than one-tenth that of Iraq.

The traveler on the Shatt-al-Arab, as the combined flow of the Tigris and Euphrates rivers is called, will soon see the reason for the supremacy of date culture in this region. Both banks of the river are lined with date gardens for approximately 100 miles up from the Persian Gulf, forming a veritable jungle of date palms. These gardens are irrigated twice a day by the action of the tides in the Persian Gulf which back the river water into channels dug by the gardener. There is no expense for this water except the labor of cleaning the ditches occasionally. With ocean steamers calling at Basrah transportation to world markets is available at a minimum cost. No other date growing country in the world possesses such a combination of natural advantages for commercial date production.

The climate is somewhat like the Coachella Valley of California with less danger of rain occurring during the ripening season. Although the rainfall in Iraq is close to seven inches, a little more than twice that of Coachella Valley, it is confined almost entirely to the months from November to April. The mean maximum temperature of Indio (14-year average) during the months of August, September and October is within one degree of Basrah, Iraq (18-year average), but the mean minimum is 3 to 6 degrees lower at Indio during the same period. Owing to its proximity to the Persian Gulf the mean relative humidity at Basrah during summer and early fall is ten to fifteen degrees higher than at Indio. This is not unfavorable to the date varieties grown there, but much less conducive to human comfort than any conditions in the Southwest. Baghdad, the capital of Iraq and about 300 miles farther northwest, is more nearly comparable to Indio. It is in approximately the same latitude and while the recorded maximum temperatures are slightly higher, one accustomed to the climate of the Coachella Valley would not notice much difference in Baghdad.

In size the present kingdom of Iraq may be compared roughly to the state of California. It contains, according to the Directorate of Revenue, approximately 12,500,000 date palms. There are probably 200 named varieties, but only about one-tenth of them are widely distributed. In fact, two varieties, Sayer and Halawy, comprise three-fourths of the date palms in Southern Iraq and two others, Zahidi and Kustawy, include about an equal proportion of the palms in Northern Iraq. There is considerable confusion of nomenclature in regard to the local varieties. In many instances the same name is applied to different dates in different localities. An outstanding example is the Khadrawy. This variety in Southern Iraq is entirely different from the date that goes by the same name in Northern Iraq, although each is well and favorably known in the section where it is grown. Incidentally it is the Basrah Khadrawy that has been established in the Southwest.

About half of the total number of palms in Iraq are concentrated in the Shatt-al-Arab area. The other half include a number of disconnected localities, the principal of which are: the Hillah-Kerbela area watered by the Hindiya Basrrage on the Euphrates; the Baghdad area watered from the Tigris chiefly by oil pumps; the Bacuba area watered by diversion canals from the Diala river, a tributary of the Tigris; and the oases of Bedra and Mandali watered by streams originating in the Persian mountains.

The prevailing soil type is a clay or clay loam much like the adobe of the Southwest. It is a trifle lighter in the foothill oases, but there are no sandy soils where dates are grown except in a few minor locations in the western part of the country.

The date harvest begins a week or ten days earlier on the Shatt-al-Arab than in Northern Iraq. By the first of September packing is well under way around Basrah with considerable interest centering on how soon the first shipload of dates can be started to New York. The dates for the United States are sorted on screen-bottom trays by native women and packed in boxes containing about 70 pounds or half this amount. This work is done under the shade of reed matting awnings at various stations conveniently located along the river.

There is little packing in Northern Iraq before the last of September, and practically all of the export from this section is to neighboring countries only. The packing is a simple matter. The ripe fruit of soft varieties is poured into date leaf sacks or goat skins, pressed tightly and sewed up. Dry dates are handled in bags of any description or stored like corn in bins for future use. Except fruit intended for immediate local consumption dates in Iraq are left on the bunch until they are all ripe and sufficiently cured to permit packing without danger of souring; then the entire bunch is cut. It is considered desirable to limit the number of bunches according to the vigor of the palm, but there is no thinning of fruit on the bunch.

Only those cultural practices which vary markedly from our own need be mentioned here. The date palms are planted much closer, ranging from 15 to 18 feet according to the observations of the writer, but owing to missing palms the actual density of the plantings would probably seldom exceed 140 to the acre. In addition to this, oranges, apricots, pomegranites, grapes, vegetables—in fact all the other crops of the country are grown more or less in between the

dates. Of course under such conditions the yields are very low, averaging only 30 to 50 pounds per palm according to Dowson.

Pruning is confined entirely to the removal of dead leaves. More than once a marked abhorence was expressed on the part of the gardener to the idea of cutting a green leaf, which was said to be "sinful."

At intervals of two or three years the better gardens are spaded to a depth of about twelve inches in Northern Iraq and about twice as deep in the Basrah area. Labor is so cheap that there is no incentive to use improved tools or machinery, so everything is done by hand in much the same manner as in centuries past.

Cover crops are not used for fertilizer. The value of manure is generally recognized but taking the country as a whole it apparently is actually applied to dates in very few gardens. It is believed that manure used in increasing quantities after the offshoot has become established will increase the number of offshoots which this young palm in turn will produce.

Each 350 to 500 palms are commonly cared for by a gardener under a contract with the owner whereby the gardener receives a share of the crop, usually one-fifth, and gives in exchange 150 to 200 days of work, and also, in some sections, the labor required to build a certain proportion of the garden wall. The owner pays all taxes and any extra labor required above the terms of the contract.

Pests

The worst pest in Iraq is the date mite. The writer estimated that about 25% of the fruit seen during the 1928-29 season showed mite injury. At Basrah many lots of fruit were observed which were rendered almost unmarketable and the low grade of fully half of the cull fruit examined was due to it. Nothing is done to check it, although the Iraq Department of Agriculture has demonstrated that it may be easily controlled. The Marlatt and Parlatoria scales occur everywhere but do not appear to be of much consequence. A large proportion of the Parlatoria scale observed had been parasitized. In fact it was not found in abundance except in somewhat isolated gardens which also appeared more or less neglected.

Varieties

While concentrating upon a study of date varieties in Northern Iraq an effort was made to determine if date palms occur in the mountains of Persia at higher elevations than they are found in Iraq. Such locations would be exposed to greater rainfall and might in the course of time have originated some variety more resistant to moisture than those of the Tigris and Euphrates valleys. It appears that there are no plantings of palms across the border in Persia east of Baghdad. Only a few hundred palms could be located in this part of Persia and those close to the border and not different from the varieties on the Iraq side.

During January, 1929, the writer made a short trip into that section of Persia below Basrah and at the head of the Persian Gulf. It was learned that some few dates occur in the mountains east of this region, but time and weather, it being the rainy season, did not permit investigation.

Near Bushire on the plain between the Persian Gulf and the mountains a new system of date culture was observed which has not been reported before. Here date palms are grown without irrigation. The rainfall is ten to twelve inches, occurring in the winter as in Iraq. This is not enough to grow dates, but the rainfall on the garden proper is increased by that which falls on a large uncultivated area above and on each side. Small embankments, radiating fan-like from the sides, conduct this water to the garden which is bordered up somewhat as here in the Southwest, except that the upper side is open to permit the entrance of water from that direction. Palms are planted about 30 feet apart and because of the limited supply of water no intercultures are grown. After the water has subsided the soil is plowed to conserve the moisture. Offshoots are set about two feet below the soil surface in narrow holes and are watered by hand from wells for the first three years. It is possible that by similar methods dates could be grown in some locations in this country.

Visability of Pollen and Receptivity of Pistillate Flowers

By Prof. D. W. Albert, Assistant Horticulturist, University of Arizona

A GREAT many problems of vital interest to the date industry have had to be solved since the introduction of the date palm into the lower valleys of the arid southwest. Many of the old world practices have been handed down to us and accepted with more or less modification to meet conditions in our commercial gardens.

The question of pollen longevity has been under dispute since the date became of commercial importance in the southwest. In the old world it has been the practice for generations to keep pollen from one year to another to use in case of a shortage of fresh pollen. There seems to be a great difference of opinion in this country as to whether or not pollen held from one year to another will cause fertilization when used to pollinate the pistillate flower.

Very little experimental work has been done with pollen longevity. Dr. A. B. Stout, of the New York Botanical Garden, made a number of tests on pollen one or more years of age. He states that it seems conclusive that pollen one or more years old is entirely worthless in effecting fertilization and setting fruit. On the other hand, many practical growers state that they have had very good success with pollen held from one pollinating season to another.

In the hope that more definite knowledge might be obtained on the longevity of pollen, the following investigations were undertaken.

Pollen Germination

Two methods of germinating pollen were used. A one per cent agar medium was prepared with 10 per cent cane sugar. The method of preparing and sterilizing this medium was that used in the pathological laboratory. A tube of this medium was heated to the melting point and a portion poured into a sterilized petri dish in such a way that when

it hardened, a thin layer covered the bottom of the dish. Pollen was dusted over this medium, the dish was covered and placed in an incubator. This method was finally discarded due to the long procedure and difficulty in obtaining accurate counts of the pollen grains after germination.

The method used in practically all germinations in this study was a sugar solution in the form of a hanging drop. A drop of 20% sugar solution was placed on a cover glass over which pollen was dusted. The cover glass was then inverted over a glass cell. A thin film of vaseline was placed on the top of the cell to seal the cover glass to it. Usually a few drops of the sugar solution was placed in the bottom of the cell as an added precaution against evaporation. The pollen was incubated for 12 to 14 hours at a temperature of 85 degrees F.

Longevity of Pollen

Male blooms were gathered shortly after the sheaths had opened. The pollen was shaken from the flowers onto a piece of paper, spread out in a thin layer and dried for 36 hours. The pollen was thoroughly mixed and placed in small glass vials. Part of the vials were sealed with cork stoppers. One-half of the vials from each of the above groups were placed in storage at 34 degrees F. The other half were stored in the laboratory at room temperatures. The pollen was gathered on May 10 and placed in storage on May 13, 1929. The pollen was taken from a large male palm growing on the University of Arizona campus. Once each month a vial from each group was opened and the pollen germinated. The following table shows results of these tests:

TABLE I. Pollen Germination by Months

Date	Cold Storage		Room	
	Sealed Vial	Open Vial	Sealed Vial	Open Vial
May 13				82.45
June 13	83.40	77.01	82.15	82.44
July 13	84.20	85.65	85.03	84.13
August 13	39.72	68.69	73.48	30.00
September 13	77.99	33.19	12.78	53.93
October 16	68.84	34.15	6.73	41.33
November 18	50.88	35.72	6.95	4.02
December 18	71.81	19.77	2.00 (Est.)	2.00 (Est.)
January 21	42.26	12.80	2.00 "	1.00 "
March 4	87.34	3.54	5.16	1.00 "

The fluctuating results are due no doubt, to poor technic in handling the pollen at the time of germination and to the fact thast each test was made from a separate vial.

During the year 1927-28, pollen was stored in the same manner as described above. The pollen was collected during the first part of March, 1927, and used for pollinating in March, 1928. The method used in pollinating was similar to the methods described by Mr. Roy Nixon in his pollen studies. That is, the female flowers were protected from outside pollen by the use of paper sleeves or bags. The pollen to be used was worked into balls of cotton sealed in paper envelopes and placed on the inside of the sleeves. After all pollen had been placed in the sleeves, each envelope was ruptured and the pollen shaken over the female flowers. The sleeves were removed 60 days after pollination. The results of these tests are shown in table II:

TABLE II. Showing the Total Number of Blossoms Pollinated and Fruit Set from Pollen One Year of Age

Pollen	34 deg. Storage				Room Temperature			
	Open Vial		Sealed Vial		Open Vial		Sealed Vial	
	Possible	Set	Possible	Set	Possible	Set	Possible	Set
Mactum Seed.	112	41	268	100	227	80	171	42
Daker Med.	155	50	194	135	336	34	100	26
Check	125	8						

Stigma Receptivity

This experiment was undertaken to determine the length of time after the spathes opened that fertilization would take place. The tests were first made during the spring of 1926. Spathes were covered when they appeared and prior to the bursting of the sheath. The time of opening was recorded. After the sheath had cracked, it was cut away and the flower clusters were divided into several parts of five strands each. Each five strands were covered with a cylinder made of two thicknesses of paraffin paper. Cotton was worked around the base of the fingers in such a way as to close the lower part of the cylinder. The top of the cylinder was also closed with a cotton stopper to allow some ventilation and to exclude pollen that might be floating in the air. A second bag of heavy craft paper was placed over the entire cluster as an added precaution against wind blown pollen, also to prevent sun-burning of the flower stands. At the time of pollination the coverings were removed and the usual field method of applying the pollen was used. Duplicate lots were pollinated each 24 hours for a period of 18 days, after the spathes opened. The results of these tests were read by request at the Fourth Annual Date Institute in 1927. The results showed in part that after 6 days, the percentage of fertilized dates decreased quite rapidly until the 13th day, after which time, no fertilized dates were obtained.

In January, 1928, Mr. A. R. Leding reported the results of a similar experiment in the Journal of Agricultural Research, Vol. 36, No. 2. He found that pistillate flowers remained receptive to a marked degree for ten days or more and to a less extent for more than 30 days.

These results were in such contrast to the results obtained by the writer that a new series of tests were outlined during the spring of 1929. Three palms on the University Experimental farm near Mesa, Arizona, were selected for testing. The nearest male palm being more than three-fourths of a mile away, there would be but little danger from wind pollination. The year previous, none of the palms on the Station were pollinated and but very few fruits had been fertilized.

In order to subject the flowers to the same or approximately the same conditions that exist in commercial gardens, no protection was given the flower clusters during the interval between the time the spathes opened and pollination. The palms were inspected each morning during the flowering period and any spathe that had opened during the past 24 hours was tagged and the sheath removed. At designated intervals, the flower clusters were covered and pollinated. The method used in introducing the pollen was similar to that described for testing the year-old pollen. When the last flower cluster was pollinated, all bags were removed and the flower clusters repollinated. Three palms, more or less isolated, were left as check palms for observing the percentage of fertilized fruit by wind-blown pollen. Results of these tests are shown in Tables III and IV.:

TABLE III. Receptivity of Pistillate Flowers—Deglet Noor Seedling, 1929

Date Opened	Days Exposed	Date Pollinated	Flowers Not Fertilized		Normal Fruit and Seed		Fruit Poorly Dev. Seed	
			No.	Pct.	No.	Pct.	No.	Pct.
May 2, 1929	3	May 5, 1929	367	32.77	727	64.91	26	2.32
April 26	5	May 1	1019	71.36	354	24.79	55	3.85
April 25	7	May 2	1352	92.59	72	4.94	36	2.46
April 24	9	May 3	1838	98.34	9	.48	22	1.18
April 24	11	May 5	1320	98.50	12	.90	8	.69
April 16	13	April 29	1645	98.68	17	1.02	5	.30
April 16	15	May 1	1808	99.12	14	.77	2	.11

TABLE IV. Check Bunches—Receptivity of Pistillate Flowers

Date Opened	Palm	Flowers Not Fertilized		Normal Fruit and Seed		Fruit Poorly Dev. Seed	
		No.	Pct.	No.	Pct.	No.	Pct.
April 17	Horra	1272	98.99	5	.39	8	.62
April 18	Korock	800	98.41	9	1.10	4	.49
April 15	Korock	814	99.15	4	.49	3	.36

Discussion of Results

The results show that it is possible to keep date pollen in a viable condition from one pollination season to another. The percentage of germination decreases rapidly after six or seven months except when held in sealed vials in cold storage. Pollen grains being so small a very small percentage of viable pollen would cause a commercial set of fruit when applied in large quantities. However, the commercial grower cannot afford to depend upon old pollen except when fresh pollen is not available.

These data show that the stigma of the date flower is receptive over a period of 15 to 18 days. The chance of getting fertilization from wind-blown pollen or from the pollen used in the test was so great that it is doubtful if the stigma actually remains receptive for the time indicated. The check bunches give a fairly accurate indication of the amount of fertilization from wind-blown pollen but does not indicate the probable error due to poor technic in handling pollen around the unprotected flowers. When a maximum set of fruit is desired, pollination should not be delayed longer than three or four days. The results also indicate that the stigma of different varieties may vary as to their relative time of receptivity.

Diseases of the Date Palm

By Dr. L. J. Klotz, Assistant Plant Pathologist, Citrus Experiment Station, Riverside, California

THE aim of this paper is to discuss briefly the pathology of the date palm and to refer to diseases of other palms which may possibly come to attack the Phoenix dactylifera of Southern California. Literature on date diseases is very meager, the few publications from the Arizona Station and one from the California Station being the only papers I have found published in America; nor have the European workers recorded much on date pathology. It is apparent that a thorough-going study of the troubles due to fungi, faulty nutrition and atmospheric factors is needed. Such a study was initiated in Arizona by members of the Experiment Station staff and in California by Dr. H. S. Fawcett who has surveyed the problems here in the Coachella Valley and recently those in northern Africa. Beginning late during the last packing season, Dr. Haas and I are endeavoring to carry on with this work. Also, fertilizer trials are being conducted by the Department of Orchard Management under the supervision of Director L. D. Batchelor.

First, let us consider the fruit troubles. Prof. J. G. Brown, pathologist of the Arizona Experiment Station, has described a date fruit spot due to species of Alternaria and Helminthosporium. The popular nomens, fruit spot, brown spot, Arizona spot, and, simply, rot have been applied to this disease. It manifests itself as small, brown or translucent brown spots which enlarge, forming oval or circular, darkened areas near the center of which the fruiting bodies of the fungus appear. In the early stages the spot may be sufficiently firm to permit scooping the affected tissue out intact as will be seen in one of the slides. The Deglet Noor is one of the most susceptible of the several varieties. Damage up to 95 per cent of the crop has been experienced in Arizona. Spores of the causal fungi are readily disseminated by wind and insects and necessarily are to be found everywhere; in fact, they are probably common soil-inhabiting organisms as are many of the species of Alternaria and Helminthosporium.

While the manner of infection of fruit has not been demonstrated, it is reasonable to assume from the anology of this disease to diseases caused by Alternaria and Helminthosporium species on other plants that penetration of the date by the germ tubes may take place through the unbroken cuticle. In the one experiment tried last winter fully sized, but unripe, dates were inoculated with a number of fungi including Alternaria, Helminthosporium, Penicillium, Diplodia, Phomopsis, and Aspergillus, all of which were isolated from date fruit or leaves. Before inoculating the fruit was washed in 95 per cent alcohol and after wounding some with a needle all were placed in moist chambers. All of the fungi grew on the wounded dates. Alternaria produced typical Arizona spot on the wounded fruit and on a few dates which were not wounded. The Helminthosporium grew rather scantily in and around the needle punctures and sporulated. Possibly this fungus requires a different stage of maturity for a rapid involvement of the date tissue. This seems tentatively to suggest that these two organisms are usually wound parasites. They do their greatest damage during wet weather and following rain injury and possibly by wind blown sand. Brown suggests that infection takes place during the more favorable conditions of temperature and moisture experienced in April, May and June. The relationships of the fungi to these factors and to the stage of maturity of the fruit are being studied during the present season.

Another fruit trouble that may follow or accompany wet weather is the so-called calyx end rot. This is a softening, rather indefinite in outline, that occurs at the calyx end of the fruit. Aspergillus niger was the organism most frequently isolated in this trouble. In several dates this fungus was found sporulating in the seed cavity just under the dried rem-

hants of the perianth or button. In the fruit inoculated artificially the fungus grew all through the flesh, causing a general softening rather than a definite spotting, as did the Alternaria and Helminthosporium. Another fungus, a Penicillium, isolated from date fruit behaved like the Aspergillus in the character of decay produced.

A rot of the inflorescence of date palm, called Khamedj or Khamage, has been reported by Chabrolin, a French pathologist. While this is not known to occur in the date gardens here, it is likely that it will appear sooner or later and we should be able to recognize and combat it. This is a fungus disease which appears as small, red spots on the inflorescence before the spathe opens and while the spathe is hidden among the leaves. The organism (Manginiella scaettae Cav.) penetrates and rots all of the spadix. It has been known to destroy 10 per cent of the young fruit bunches. Control consists in removal of the infected inflorescences and destruction by fire, and in spraying or dusting the unaffected ones with lime sulfur, Bordeaux, or Burgundy mixture. The Arabs mix a handful of copper sulfate with three handfuls of powdered lime and place this at the base of the fronds around the heart of the palm.

Black nose is another important trouble of date fruits that calls for discussion. Losses from this disease, if it may be called such, are variously estimated. I have no figures, but since the trouble necessitates such severe grading, the monetary loss must be heavy. Black nose is characterized by a darkening and a slight or severe cracking of the distal end of the dates involving as much as half of the flesh. The cracks offer a good harbor for fungi and the air-borne forms are especially prevalent. Rhizopus, Penicillium, Hormodendron, Alternaria, Phomopsis, and several species of bacteria have been obtained from fruit having this injury. However, several plantings made from the inner tissue before the cracks had formed remained sterile which to me indicates the trouble to be physiological or nutritional. Several hypotheses to account for the trouble have been propounded. Some of these will be tested during the present season. Frost injury of the distal end of the fruit in the spring has been thought to be a factor in the prevalence of black nose; as has also humid weather at the time of blooming and setting of fruit. Because of the prevalence of the trouble in the Deglet Noor variety, which is a cane sugar date, a relationship to cane sugar has been suggested. Mr. R. H. Postlethwaite suggests the theory that at certain stages of sugar and moisture content the date under certain drying atmospheric conditions transpires water faster than the sugar manufactured in the leaves can be translocated to the fruit to take the place of water lost to the air. During such times the tissues would be injured by desiccation and black nose would be the ultimate result. To this I want to add a supplement. If an analogy to the vapor pressure of solutions is correct, the greater the sugar content of the date the greater the retardation of transpiration; hence the initial injury would likely occur before a high percentage of sugar is laid down in the fruit. If it is true that the cane sugar dates are more susceptible to black nose than invert sugar dates (I have been told that they are), a possible explanation is as follows: Weight for weight glucose or fructose (the monosaccharides of invert sugar) would have a greater power of retarding transpiration than cane sugar, a disaccharide, because a molecule of the latter, although it is almost twice as heavy, could retard transpiration no more than a molecule of the former; consequently, it would be reasonable to expect a greater incidence of black nose in the cane sugar dates. No doubt there are other factors operating and it may not be so simple as this simple physico-chemical relationship suggests, but even a simple theory is more satisfying than no theory. This hypothesis will, in a measure, be tested by determining the relative rates of transpiration of the basal and distal ends of fruit at various stages of development. The comparative sugar content of the two halves should also be determined.

So far as I know, little has been done toward controlling these fruit troubles. Sulfur and Bordeoux mixture have been used. J. G. Brown of the Arizona Station in the 1921 report states, "Fruit clusters sprayed this season with 4-4-40 Bordeaux mixture remained free from date rot fungi thus far." During the present season we are trying out a number of sprays, dusts and gasses, including Bordeaux, sulfur, lime sulfur, chlorine, carbon tetrachloride and carbon disulfide.

Here we leave the fruit diseases and mention a number of more or less minor troubles of the date palm, some of which under our conditions might become important. The Graphiola disease manifests itself by producing numerous dark-colored, smut-like pustules on both sides of the leaves. Microscopically these pustules at maturity are seen to consist of round or elongated hard, black cups within which is a yellow bundle of spore-bearing threads which protrude above the black outer structure. While it is now of no importance in the Coachella Valley, it is an important disease in northern Africa and may possibly become of economic significance here. However, as Dr. Mason observed in Africa and as is indicated here in the West, the occurrence of the disease appears to be directly correlated to a sufficient atmospheric moisture. It occurs on all species of palms in Africa, in San Diego County, and the coastal sections of California. The report of the Arizona Commission of Agriculture and Horticulture for 1925 records the occurrence of the disease on seedling palms in the Yuma and Salt River valleys. All infected shoots were dipped in a 4-5-50 Bordeaux mixture which, it is said, prevented a recurrence of the disease.

The leaf blotch or dry bone disease, named by Dr. Mason and by him brought to the attention of Dr. Fawcett, appears as grayish-brown, irregular areas occurring on the midrib and pinnae. Nothing but bacteria has been isolated from these lesions which generally are not sufficiently abundant to be of much economic importance. It is, however, rather generally distributed and on one group of seedlings in the Government Date Garden appears to be doing some damage.

Another trouble, bud scorch, has received some attention. Young leaves as they emerge and develop are not infrequently seen to be warped and distorted. This is usually accompanied by a blackening of the midrib. Dr. Fawcett has obtained some Fusaria and Penicillia and in one case a Diplodia from the darkened midrib. In the one specimen recently tested I obtained a Diplodia from the necrotic area. It may be that some of these organisms initiate an injury which results in the distortion and the "cross-cuts" and "V-cuts" frequently found near the base of the midrib would be an ideal ingress for the fungi. These latter injuries probably originate at a very early stage in the development of the rapidly expanding fronds near the bud of the tree or offshoot. A small mechanical rupture, due to binding and pressure

and rapid growth, would in the tender tissue likely develop into the cross-cut and V-cut injuries as we find them. Dr. Ralph H. Smith of the Citrus Experiment Station could find no evidence of insect injury in connection with this trouble which, I may say here, is minor.

Another minor trouble is the so-called "fool" disease or distortion in which the terminal bud suddenly begins to grow laterally instead of vertically. The cause of this has not been determined but I have found it occurring in conjunction with the bud scorch just described and a bud rot found recently. It would seem that some organism or mechanical injury due to rapid growth must initiate the trouble.

Mr. B. S. Boyer has called our attention to a bud rot of one of his six-year old palms. The young fronds and bud were almost completely decayed away at the base, the affected tissue being black and hard in contrast to the soft character of the decay in cocoanut bud rot caused by Pythium palmivorum. The identity and pathogenicity of the fungi isolated from this palm have not yet been determined. One organism was particularly abundant. Tentatively I express the opinion that this trouble and the "fool" disease are connected because in the two cases of the latter examined the typically hard black decay of the leaf bases was present.

I just want to mention at this point that the trunk and bud decay of Washingtonia palms, leaf decay and trunk rot of Canary Island palms, and the Kentia palm leaf spot are serious diseases of our ornamental palms which thus far have received little attention. Penicillium roseum, Fusaria, a Cephalosporium, and a Pestalozzia have been obtained from affected tissue, but the pathogenicity of none has been proved. However, a leaf disease of the cocoanut palm has been shown to be due to a Pestalozzia.

Two years ago Dr. Fawcett began an investigation of an offshoot and leaf stalk disease of palm which he showed was due to a Diplodia closely resembling the species natalensis of citrus. His report of that investigation, I believe, has been placed in the hands of date growers. The seriousness of the disease on transplanted offshoots is illustrated by several losses reaching as high as 50 per cent of the stand. How this serious aspect can be obviated I shall tell presently. Described very briefly the symptoms are as follows: Depending on the location of initial infection, either the outside leaves first may be attacked and killed or the bud and young leaves may succumb before the older leaves. If the outer whorl of fronds is first invaded the disease usually works progressively inward until it finally kills the bud; however, there is evidence that a rapidly growing offshoot may grow successfully abreast or ahead of the fungus. On the leaf stalks of both the offshoots and the larger palms the disease appears as yellow to brown streaks extending lengthwise as much as several feet in some instances. The central axis dries and shrinks and the frond dies prematurely. The importance of the disease on the offshoots is obvious. Direct damage to the larger palms is often not evident, but any factor that lessens the natural life span of the leaves is obviously of economic importance.

The fungus, Diplodia species, has been isolated repeatedly from the diseased offshoots and fronds and proof of its pathogenicity readily secured. In one instance a leaf artificially inoculated bore after a period of three months a lesion five inches long. The Deglet Noor variety appears to be very susceptible, but no varietal tests have been made. However, I have isolated the organism from a diseased leaf of another variety, indicating that it can attack other varieties. The one seedling palm we tried repeatedly to inoculate was found very resistant. Thus far we have observed the disease in and isolated the casual fungus from fifteen different gardens, which suggests a wide distribution. The spores of this fungus are borne in flask-like structures called pycnidia from which when moistened they are projected in gelatinous matrices called spore horns or spore tendrills, like grease from a grease gun. This sticky mass of spores may be disseminated in various ways. Rain will dissolve the matrix of the spore horn and splash the spores which may then be distributed throughout the garden in irrigation water. By means of glycerine spore traps Burril and Barrett in Illinois found that the spores and spore tendrils of Diplodia zeae of corn ear rot were carried at least 350 yards by the wind. Man in pruning the trees and cultivating the orchard would no doubt be an active agent in the distribution of the organism. Birds and other animals and insects would also play a part. From this it is evident that one may expect to find the Diplodia disease in all parts of the Valley.

General orchard sanitation consisting in removing and burning any frond that shows suspicious yellow or brown streaks is the primary recommendation for control. Where the disease is known to be abundant the pruning instruments had best be dipped in a disinfectant, as a 5 per cent solution of formalin, after the removal of each leaf. With offshoots so plentiful as they are at present any that show symptoms should be discarded from the planting program and destroyed. However, if the price justifies it, many offshoots in the early stages of the disease may be reclaimed by cutting away the diseased tissue with a sterile knife and disinfecting the surface with a .1 per cent copper sulfate solution or a Bordeaux paste. As a general practice pruning cuts and the cut surfaces of the offshoot and mother palm had best be disinfected by painting with a Bordeaux paste. In addition to these suggestions a thorough spraying of the palms with ammoniacal copper carbonate, as given in Dr. Fawcett's paper, may be practiced. One grower who applied this spray last fall reports an improvement in the general appearance of the sprayed trees. In this orchard, however, another disease was the important consideration.

This brings us up to a discussion of probably the most important trouble of date palms in the Coachella Valley. It is known as the stunted growth disease or slow failure or degeneration disease, and its characteristic symptoms are a lack of vigor, a cessation of growth, slow deterioration and finally failure to produce fruit. The general color of the tree is a pale yellowish green. While Diplodia-affected leaves are frequently found in connection with this trouble I do not believe they have any primary bearing on the disease; more likely the fungus finds the stunted tree a more susceptible host than a vigorous palm. A thorough dissection of an affected palm revealed apparently normal tissues throughout the bud region and entire trunk. Diplodia was isolated from some of the leaf bases. One finds more dead roots on diseased than on healthy trees and some of the caps of the feeder roots show an encircling blackened depression. While, as yet, we have found little apparent difference in the fungus flora of the roots and soil of diseased and healthy areas, this study has not been sufficiently thorough and more is being done. The fact that the rather well defined areas containing diseased

plants enlarges as time passes, suggests a trouble of parasitic origin. However, our most promising leads thus far have been from the standpoint of nutrition. The soil of the entire experimental orchard having both healthy and diseased trees has been fertilized so that the area supposedly contains similar plant food materials, but, as Dr. Haas will explain in detail this afternoon, comparative chemical analyses of the pinnae show that certain elements are being absorbed differently by the good and bad trees.

It should be mentioned here that one diseased palm that received 50 pounds of copper sulfate applied in a basin around the tree shows a marked improvement in its appearance, and the chemical picture of its pinnae now resembles those of the pinnae from healthy trees. This tree is making a good growth and putting out a number of fruit stalks. It now has 65 leaves as compared to 59 leaves possessed by a comparatively check tree. In this work we are not losing sight of the possibility that the chemicals applied may have had some effect on an undiscovered parasite and that the improved chemical picture resulted secondarily. Our efforts at the present time are largely directed towards a solution of this trouble. In addition to soil treatments Mr. Postlethwaite is injecting various chemicals into the trunks of diseased trees. In the laboratory the comparative analyses of the leaves are being continued and comparative chemical studies of the soil before and following the treatments, are planned. In the greenhouse experiments designed to reveal the nature of the mineral nutrition of seedling date palms are under way. While only a beginning has been made in this work, I believe the results obtained are of significance.

In conclusion, attention should be again called to the mysterious and extremely destructive Bayoud disease which Dr. Swingle described and discussed at the last Date Institute. Word from Dr. Fawcett in Algiers re-emphasizes the grave seriousness of this trouble and everyone should be on the lookout for it.

Fertilization

By Horace Dunbar, Director of California Soil Improvement Committee

DURING seventeen years of almost daily contact with the California farmer, I have had the opportunity of learning something concerning how the farmer is thinking, and something about what he wants.

Long ago I made the discovery that he did not want advice. He will sit patiently and listen courteously to what one may have to say, then he will go home and forget all about it. Should he recall what he heard, it will be to chuckle over the speaker's ambitious and voluntary efforts to lead him from the depths of the wilderness into which he has blundered.

The farmer wants facts, demonstrations, something new to challenge his thought as he drives back home. Advice always in some manner smacks too much of superiority, of a gratuitous guardianship, and it is human nature to resent it a bit or to suspect that there is a catch in it somewhere.

Men go about in the world talking and advising on matters of which they may know much or little, but it takes genius to set the world thinking as you do.

Soil fertility does not yield to genius. It involves too much time, hard work and straight thinking to be a matter of flashing inspiration. Whenever I see any one boldly plunge into the complicated subject of fertilization, learnedly mapping out a definite program for the farmer, without an intimate knowledge of that farmer's soil conditions, I always think of the fellow in the show who keeps trying to fit a No. 6 hat on a No. 8 head. Perhaps the average farmer sees it in somewhat the same way.

Embarrassing questions frequently are asked the man who claims to know too much, for example—do I need to use lime or potash or phosphoric acid? The learned speaker can say yes or no, and still be unconvincing. He may straddle the question and suggest that the grower might try these out for himself.

To thus shift the responsibility is not only unfair but downright dangerous, for it carries with it the impossible assumption that all one has to do to determine whether a soil is deficient in any element is simply to apply that element and abide by the results.

Unfortunately, fertilization is not as easy a proposition as that. There are too many concurrent causes leading to results for any one factor being considered sufficient and final. As it is the purpose of my talk to deal with this phase of fertilization in order to emphasize the need of practical soil research, I hope you will forgive me not offering you any magic fertility formula which will accomplish the same results in all soils regardless of what the type and fundamental conditions of those soils may be.

Indeed it would appear an easy matter to demonstrate that lime was needed on a soil by adding lime. This ought to get the necessary results, and frequently it does, but often lime may be only one of two or several limiting factors, while a solution of the problem lies in meeting and correcting all those factors, not any one alone.

A soil, then, may be in need of lime and still fail to respond to lime applications, not because lime isn't required, but because it is impossible for lime to function properly under such impossible conditions.

To illustrate,—it has been ascertained that a laboratory determination of the need of a soil for lime very often fails to bring about the same results in the field. The reason for this is that there are more requirements for lime in the soil than one can measure accurately by laboratory test. But when the field and laboratory investigations are joined, you come closer to getting the complete picture of the situation and, incidentally, results are achieved.

Further, it generally is thought that no matter in what form you add lime to a soil, or in what form you add nitrogen to a soil, a plant will absorb both in the chemical combination known as nitrate of lime. A soil, therefore, needing both lime and nitrogen, would not reflect such crop improvement as to indicate that either was required were only one alone of these added to the soil.

I recall a fertilizer experiment where it was sought to prove whether or not the elements ordinarily entering into commercial fertilizers were, after all, essential as fertilizers. This experiment was conducted along lines wholly unique, in that several concurrent essentials were totally ignored, and I naturally maintain that any such test that directly

prohibits the natural soil processes throughout the experiment does not constitute a fair practical demonstration at all. You may enter the fastest horse in the world in a race, but if you keep him tied in the barn during the race, it certainly is no test of his ability to run.

Let us consider the conditions under which this test of plant-food elements was conducted. It has been authoritatively admitted that the moisture content of the soil throughout the test was kept as nearly uniform as possible. By uniformity of moisture is meant as steady and unchanging a moisture content as possible, in other words, a wet soil on the average. There was, to say the least, an absence of fluctuating moisture such as authorities agree today must be the basis of any adequate system of irrigation.

A uniform moisture content meant rather conclusively an absence of proper soil aeration. As long as water fills the soil, air cannot enter. A fluctuation of soil moisture in a normal soil means aeration, for air enters the soil as the water leaves. Hence, an absence of air meant the absence of oxygen so necessary to normal health and activity of the soil micro-organisms. Without these micro-organisms there can be no fertility, and, at least, nothing like normal soil processes.

Again, throughout the years of these particular experiments clean cultivation was practiced, which means that no cover-crops were grown and no manure or other organic matter whatever was added.

The soil used in this experiment was and still is known to be very deficient in organic matter.

So the stage was set for these experiments, the results of which were to determine the fertilizer program of a great agricultural State, where many thousands of farmers paused in their fertility program awaiting the results of this test.

It is certainly reasonable to ask what is the real value of any test so conducted? Should a farmer duplicate the conditions under which these experiments were carried on, he doubtless would get the same results. But what good would that do him? If they were carried on to show the farmer what not to do, we might give them welcome, but when they are interpreted as a practical program which the farmer should follow, the farmer should consider the lack of profitable results before he decides to adopt such a system of soil care.

So the mere application of any fertilizer does not necessarily demonstrate its need. There are so very many factors contributing to soil fertility, all which are necessary and none of which can be substituted for any other. Fertilizers are only a part of the program, and fertilizers have a somewhat selfish way of requiring congenial associations in the soil. The history of fertilizers the world over is that the better the farmer the better are the returns from the use of fertilizers, because being good farmers they have seen to it that their soils are in such shape that fertilizers would have a chance to function properly.

Many seem to believe that fertilizers should be used only after a soil is rather far gone. The better the soil, however, the more fertilization pays. Once soil fertility is gone, far more than commercial fertilizer is needed to restore it to usefulness.

Let us look at this from another angle. I have in mind a recent cotton experiment. The soil in this case was woefully deficient in two elements, nitrogen and available phosphoric acid. Other crops, lettuce in particular, had been vastly improved by the addition of sulphate of ammonia and superphosphate in that neighborhood, and the experience of the cotton-growing South had shown that cotton responded readily to commercial fertilizers.

But this cotton experiment here in our Southwest was a complete failure. Investigation showed that the roots of these plants were down as deep as six feet, while the phosphoric acid added had become fixed in the uppermost two or three inches of soil.

Conditions such as these must be properly understood and reckoned with and it is very possible that this particular cotton experiment will discourage any further experimentation for some time to come, and the cotton industry materially retarded, simply because a comparatively simple factor was totally ignored. There is no substitute for comomn sense.

Not long ago an independent investigator, and one of the outstanding California authorities on soils, Dr. Dean D. Waynick of Anaheim, found a very unique situation in an Orange county citrus orchard. Year after year for fourteen years, a high grade complete fertilizer had been applied to this soil, yet there was only a trace of phosphoric acid below the surface 8 inches of soil.

A wrong fertilizer practice, therefore, may not be confined solely to the ingredients used or left out, but the time and manner of application may be wholly at fault. It is my sincere conviction that here in California we have a vast lot of work ahead of us to determine not only what particular plant-food elements are required, but to determine how much to use, when and how application should be made. There is so much necessary work to be done along this line that any advice partaking of any degree of assurance or finality is impossible if not downright ridiculous, especially when it involves all California soils, where such a multiplicity of types exists.

Is it any wonder that there exists a constant and futile controversy in California in relation to fertilizers and fertility? We might as well argue religion, and I never yet knew an argument on religion to get anywhere.

There is a vast difference between a total supply of phosphoric acid or potash in the soil and a sufficient amount of either or both sufficiently available to support economic crop production. Your soil may contain enough of these elements to care for a thousand annual crops, but unless both are available to such extent as to care for the needs of the immediate crop, they might as well not be there at all as far as that immediate crop is concerned.

Availability, therefore, is quite necessary and availability involves many known and suspected factors not easily gauged and controlled.

Availability would be robbed of most of its difficulties were it merely a matter of bringing it about, of winding it up, as it were, and letting it run undisturbed and continuously. Under such an ideal but impossible state of affairs, the soil solution would flow smoothly up and down, bathing the plant roots and enabling the roots to absorb essential plant-food elements when required.

So much more is involved than this. Soils and soil solutions are not static, but dynamic. Soil solutions vary in movement and concentration in accordance with the amount of water in the soil, temperature and the physical characteristics and properties of the soil. The only constant phase of the soil solution is change.

So many of our soils are collodial, involving the steady exchange of bases, removing them from or adding them to the soil solution continually. So long as the soil solution contains the essential elements and conducts them to the plant roots, all

goes well, but trouble follows when the soil solution is lean, or when it is amply provided with nutrients and prevented by adverse soil conditions to come in contact with the roots. Physical soil conditions, then, have a tremendous bearing upon soil solution movement, regardless of how generously a soil may be provided with total or available nutrients.

Now all this may sound needlessly technical, but these things are all involved in the matter of soil fertility, which after all is a matter of meeting soil and crop requirements. A knowledge of these things not only is involved, but a knowledge of how to determine and direct them as well, and no adequate research system will ignore them.

A year or so ago we had the pleasure of entertaining in our home our friend, Dr. Wilmon Newell, Dean of the Florida Agricultural College. We talked soils and soil research day after day which, for me, was a splendid privilege. Dr. Newell told me the details of how the Florida soil authorities worked upon and solved the fertility problem of the reclaimed Everglade swamp areas. When drained, these acid peat soils refused to respond to any of the ordinary elements of fertility or soil amendments until forty pounds of copper sulphate per acre were first used. This began an entirely new chapter for Florida agriculture and research.

Tomato growers in Florida were having large losses through a mysterious disease of the plant. After considerable difficulty it was noticed that manure at times cured this disease, but at times also failed. It was found that the manures which did cure were shipped into Florida from other States, but Florida manure did not cure the trouble. Analyses disclosed that outside manures contained manganese but Florida manures did not. Manganese then was tried and was the secret of the cure.

These two instances are mentioned to illustrate the need and the efficacy of adequate research, not laboratory research only, but a system of research which combines both the laboratory and the field. The farmer if left to himself eventually will find out many important facts about his soils, but adequate soil research will solve speedily where it would take the farmer many years. What we want is research that will benefit the farmer of the present generation. The farmer of the future will know more than his father, and the farmer of today should know more than he does. There is less known about soils today than about any other phase of farming, yet more is known about soils and soil processes than the farmer has a working knowledge of. If the farmer of today really appreciated how research knowledge in existence would benefit him if properly directed towards his individual problems, he would bend every energy upon its proper utilization.

Personally, I do not believe that the State or National Governments will ever be the logical agencies to direct in individual cases the application of research results. Their chief function, as I see it, is to carry on fundamental research, the development of scientific principles, the actual application of which is not a proper governmental function, but something which the farmer or his farm organization should arrange and finance.

The outstanding industrial enterprises of America would not be where they are today if they had depended upon the State or National Governments to do their research work for them. They helped themselves, just as agriculture will have to do to get anywhere.

In some States where there is uniformity both of crop and soil, the latter being established by constructive research, practical programs of fertilization can be outlined with some degree of safety. Soil principles are the same everywhere, but their application must be in harmony with existing conditions. Here in California with our innumerable soil types, varying climatic influences, different physical soil characteristics still further influenced by irrigation practices and differences in irrigation water, our intensive and exotic crops, we certainly need individual programs adjusted to individual problems.

By this I do not mean to imply that our farmer must surrender his initiative and refuse the common sense dividends of practical farming, but these should be reenforced by every possible scientific fact developed by research. For some time I have been making a survey of cultural practices of citrus growers, and in each instance I have found a successful grower to be first of all a thinker, a good farmer to begin with, possessing the ability to profit by experience and not easily thrown off the track by contact with advisers who offer a substitute for hard work and direct thinking.

It is not that these successful growers know it all, but they know enough to use what they know and to keep on learning.

Groups of farmers over the State are employing soil chemists who establish laboratories within the community they seek to serve. At first these scientific men who have turned practical applied themselves to the study and control of soil moisture, a fundamental factor in fertility in all irrigation farming. Some of these laboratories are broadening their operations and going directly into fundamental soil conditions where and as they are. To my way of thinking, this is exactly the one way of going about solving your own particular soil problems, including those of fertilization, of course.

The medical profession studies each patient for symptoms so as to prescribe for the exact disease involved. Dandruff and smallpox demand different treatments. California agriculture must start to work along the same lines.

When you date growers know how much water you should apply, when and how best applied in answer to your individual soil and plant needs, when you know what your soil should have in the way of fertilization, when and how to apply it so that it will be available to feeding roots, you will have the results of research in its broadest and finest sense, and I know of no other satisfactory way to find these things out.

Sales Problems

By Geo. D. Olds, Jr., Sales Manager, Hills Bros. Co.

WHEN the consumer bought macaroni in 1921 she paid 41½ cents out of every dollar she spent for getting the product from the factory platform to her pantry shelf. This was the story told by the Congressional Committee of Agricultural Inquiry. In corn flakes she paid 47 7-10 cents of her dollar for this same distribution job. These were not exceptions. There were many cases just like them or worse. The food world suddenly began to realize what an enormous change on living distribution had become.

It must be admitted that since that time, manufacturers and producers of foods have not done very much to cut that cost. It took us a long time to learn what it meant to be in a buyer's market and is taking longer to discover what we can do about it. So that there may be no misunderstandings here today let me tell what I mean by a buyer's market. Since the end of the war boom our capacity to produce goods has been greater than our normal consumption. Under these conditions the buyer of goods can choose from whom he will buy and can nearly dictate his terms. I am inclined to conclude from study of similar trends in the last 100 years, that we can expect this situation to last fully 20 years more, and should adapt ourselves to it as best we can. The wholesalers and retailers as a whole were not much quicker than the producers at tackling this problem. Some of them were, however. They became so efficient that they grew to have many outlets and became chains. They discovered the appeal to the consumer of cash and carry, self-service, convenient store arrangement and location, national brands, and freshness that comes from rapid turn of stock.

Some have thought that distribution mergers were a step in this direction. But the outstanding feature of distribution cost is the item of selling effort for which the consumer may very logically refuse to pay. Reduction of this item demands lessening of sales resistance more than increase of sales power. Mergers surely gain financial and sales power. If they apply it as group effort to analyze and improve methods they are well justified. The success of some cooperatives which have aimed at this object is natural. Applied to dictation of sales terms, however, merged power is opposed to the principles of distribution in a buyer's market. Use of this power stirs up resistance which is costly to the industry and ultimately effects the power. It postpones the inevitable result of over production.

Now all this sounds very complicated and far-removed from your interests; but you and I are producers who are affected vitally by these conditions and will be still more as time goes on. What can we learn profitably from such a condition? We can learn first, that success will come quickest from reducing sales resistance; second, that sales resistance can only be reduced by our finding out the needs and desires of our buyers and adapting our products and our methods to them. In branded merchandise always, in bulk usually, our ultimate buyer is the consumer. Let's take a good look at her. I say "her" because women buy 95% of American food.

What consumer? The American consumer? Let's stop imagining that there is such an average person. Nor is there any complete American market except in the mind of the financial executive. If we could study the United States through a telescope we should see only a large number of local markets in which were a great many different people. They may be very crowded or scattered; black, white or yellow; natives or born in Iowa; farmers or office workers; warm or cold; rich or poor. All of these variations will help settle the question of what they eat. If they get their recreation sitting at home they are apt to eat good meals, home-cooked. If they take a drive all day Sunday sandwiches or a restaurant meal will determine what they buy. The fact that fresh fruit is hard to ship to Minnesota means that dried fruits to some extent take its place and we find a high consumption per person in that state.

Habits have a powerful effect on consumers' choice of food. What started the trade and the public in the habit of ceasing to buy dates after Christmas we are not sure; but the habit is so strong that years of advertising and sales pressure have only made a little dent in this habit.

You see we must first find out, by separate local investigation, what these many types of people eat and how. Trying to sell where we have not found out will be costly and probably unsuccessful. Nor will finding out once, only, be safe. Wants change so fast that we must keep on finding out all the time. Dromedary Dates for example have, in the past ten years, changed greatly in type, grading, quantity, arrangement, method of packing, processing. The package has changed in size, shape, design, color, material, price. All of these changes were the result of market study,—attempts to keep up with change in consumer wants. We must, secondly, find out what consumers do not eat but could if it were offered. From such a study comes knowledge of a specific need in product and style of presentation that is opportunity for producer's profit. Dromedary Grapefruit in cans was the result of such a study. We did not decide to pack it and then go out and sell. We searched the consumer field for a spring and summer need that we could undertake to fill. Canned grapefruit was the answer. This matter of learning the consumer is not a quick nor easy job. It must go on all the time and one is never certain that he has the answer.

After we think we have learned something about our consumers we must examine the distributors, the wholesalers, retailers, and chains. I shall not cover these in detail. There is great confusion and constant rapid change among them. From the decision as to what channels of distribution shall be used will come the specific needs for our product's packing and pricing. Then it becomes necessary to analyze our production facilities and costs to meet these specific needs. The planning and execution of a campaign will follow naturally if aggressive, intelligent, honest leadership is provided. So the buyer's market I was telling you about has forced us to revolutionize our process of thinking as producers of food products. In the good old days of the sellers' market when we could name our terms we used to say, —if, indeed, we thought about it at all:

"What have we to sell? Through whom shall we distribute? Finally, to whom are we going to sell it?"

In the annoying present day of the buyer's market we must reverse the order and ask:

"Who and where are our possible consumers and what will they buy? Through whom can we most economically reach them? How can we produce at a profit that which these people will buy?"

Thus the requirements of distribution reach back of the shipping platform into the packing plant and its processes. Yes, they reach further back than even into the source of the raw material. That means to you and me; our date gardens.

You will pardon me if I try to make this concrete by giving you a very incomplete sketch of our experience in applying this principle to Dromedary Dates.

Time would not permit telling you the interesting variations in consumer acceptance of this package which our division of the country into 379 trading areas presents. I shall attempt only broad generalizations because they illustrate my point most clearly. By widespread observation we have found a price-level beyond which we can expect sales will cease to increase quite regardless of quality of the product. That is, up to a certain point the consumption will increase even if the improved quality costs more. Beyond that point improved quality is of interest only if it does not raise the price. The size of the package preferred has decreased by various stages over a period of years from 16 to 10, and in the pitted package, 7¼ ounces. How far the hand-to-mouth consumer buying will carry us in this we cannot tell.

When we attempt adaptation it is important that we know how dates are used. Our latest consumer survey shows that 68% of dates bought in the retail store are eaten "as is." Dates as an ingredient are not widely used. As a result of this we are in the process of change now to a carton that provides candy-box convenience. Selecting out dry and putty-ended dates, and foreign matter is an obvious necessity. As for bacteria, though the popular idea of their commonness on imported dates has been greatly exaggerated, nevertheless they are present in sufficiently frequent cases to call for treatment. The highly developed pasteurization process, with its specialized machinery, has been the outcome. It represents our response to a popular conception.

The habit of eating dates only in the holidays had no sound basis. However, no attempt to break this habit could succeed unless the package would keep the dates fresh for months under any conditions. Dry dates, perfectly wholesome to eat, are rejected by the consumer. The double wax wrap has been developed from this demand.

To expect our Brooklyn packing plant to meet all these conditions with the ordinary run of imported dates was asking too much. The dates must arrive in better condition, be more carefully graded and packed in Iraq. Semi-mechanical grading and machine packing of dates destined for Dromedary packages resulted. Even this did not go back far enough to guarantee the adaptation to consumer wants. We had to install our own packing stations at the date gardens, and finally to undertake the growing of our own dates. Our gardens are only eight years old so they do not as yet greatly influence the raw material supply. But every move in those gardens is made with the single idea in mind of adapting our raw material to the insistence of the consumers in this country. Thus you can see in process the very principle I have urged upon you as necessary in this buyer's market. We cannot stop short of the soil itself in the effort to grow, pack, process what the consumer will buy.

This is my reply to those of you who may be saying that you cannot tamper much with what comes from the soil, that adaptation must start at the packing house. So it can; but it is far less costly to grow to specification, as far as possible, than to try to pack to specification what is grown haphazard. The specifications must be accurately known in either case. So you see the modern distribution manager is a hard taskmaster. He must, of course, be reasonable. He must understand the growers' difficulties and limitations. But he absolutely must control where an industry hopes to equip itself to meet the conditions of the next 20 years. Only he has the outside contacts which provide the opportunity to see conditions in the market, and, more important still, to study their trends as they change.

We have long watched the difficulties you have survived and have always been impressed. Climatic uncertainty and pests you have very nearly mastered. Jealousies and sometimes inexcusably poor advice have cost you thousands of dollars, and worse, years of delay. Destructive self-interest in the disguise of unselfish devotion has caused misunderstandings and irreparable losses. Yet in spite of all these hindrances you have achieved phenomenal results. The Dromedary Company may distribute a lot more dates; but we bow to you when we consider your clean-cut product whose appearance we can hardly ever hope to equal. And your date culture is the model for countries whose thousands of years of experience should never have to look abroad for instruction.

Only recently has distribution as a problem thrust itself upon you. Of course you will always have it from now on. Also of course you will probably succeed in meeting it. You will have to realize that you can pack only what your distributors find they can sell. You must understand that in a total food consumption of $24,000,000,000 a year dates amount to only about 3-100ths of one per cent; that such small volume offers little incentive to the average retail store to push their sale. You will have to find out what the consumer wants in appearance, size, color, style of pack, keeping quality, season of ripening,—finally, cost to buy; and then, by hook or by crook, you will have to offer it to her. Your past losses may be a heavy charge on your cost to produce. Like the intelligent seller you will have to write off your losses early. The consumer is very human in her wants, but absolutely inhuman in her ruthlessness. Unfortunately it is nothing to her whether we lose through past error.

You will have to bring to your problem the realization that it is a day of specialists; that distribution requires this as much as growing. It will be obvious that one grower alone cannot afford to employ such specialists; that, cooperating as a unit, a large group of growers can. You will have to listen to your specialist when he tells you what can be sold and you must bend every effort toward producing that product.

In all this process you will have to arrive at a new state of mind, adopt a new attitude. You will have to see that distribution problems reach right back into your date gardens and determine for you in some degree even what soil, what fertilizer, what varieties, what pollen, how much water shall characterize your growing methods. They will tell you what must be your maximum cost.

You cannot escape these implications. If you dodge them your competitor will not and you will be left behind. The answer is not in your power but in that of the consumer. She will demand change of you when you think you are well on the permanent path. She will insist that you have unlimited patience and a willingness to learn, to tap every source of distribution knowledge even if it violates your longest established habits and most cherished preferences. All this I believe you will do because you have already done so much. But the effort will be a severe one.

Now one more word, this time in a more intimate vein. The Hills Bros. Co., the packers of Dromedary Dates as only one of a growing family of products, is no great octopus. As food companies go we are not even large. Small or large we have determined to keep our business personal, to keep it human in interest and action. Please don't think of us as big and apart. You and we have a joint problem. Don't you think for a minute that we have the final answer to this problem. We know we are far from it, and we are persistently aware of change so continuous that, even as we approach a solution, the problem has become a new one to be solved. What little we have found out in date distribution we should be glad to share with you. It is impossible, of course, at one sitting; and that is why we want to meet you oftener, get to know you better, and exchange ideas in a common effort to build better the distribution of dates in America.

DISCUSSION

Col. Dale Bumstead: What is the per capita consumption of dates in some of the larger European countries and some of the Moslem countries?

Mr. Olds: In the Moslem countries there is no way of telling. Populations are not well known nor is the volume of dates acurately calculated. In England the per capita consumption is about 1½ pounds or three times what it is here in the United States. In Australia and New Zealand it is only slightly less and is building up. There is our potential outlet — consumption in both countries can increase to some extent. Germany is below the United States in per capita consumption. We do not know the exact figures. Most of the dates consumed there are North African in origin and are not imported directly to Germany, but reach there via other countries.

We have been studying some date market reports quite thoroughly. Dates sell there at about the same price they sell here but they do not know what a package of dates is, except the oval pressed packages from Marsailles, which are mostly wormy and very low grade. In France there are very few dates consumed. Most of the dates imported to France are received at Marsailles and re-exported.

Col. Bumstead: What about the Scandinavian countries?

Mr. Olds: It would seem reasonable that they consume quite a few. When we first experimented on putting boxes on the market in Great Britain our manager also went to Norway and Sweden. He came back with a report that although dates were being eaten there the population was so sparse it was not worth investigating.

Mr. Bryan Haywood: You made the statement that there was a price limitation above which dates cannot be marketed. What is that price line?

Mr. Olds: I left that question open so there would be discussion. I referred to imported dates. California is not considered a competitor in this market.

We find we cannot go beyond the price of 25c per package of 10 oz. (Actually the packages weigh a little over 11 oz., but they are marked 10 oz. on the wrapper). This is approximately 35c a pound. Beyond this price dates stay on the shelves regardless of fancy pack and special dates. This 25c package means in the food-service expensive retail grocery stores. They are not over 23c in the cash-and-carry stores, and in chain stores 21c. We find large chains selling dates for 19c as specials. We also find that the 19c price does not sell any more than the 21c price. There is a certain psychology in the situation. Above 25c in the service stores and 23c in the cash-and-carry we have been unable to market dates in quantity.

Question: Does your company think you are going to be saved a large amount of expense in future because of the greater growing interest in America and in Europe in food, diet and allied subjects?

Mr. Olds: Yes. There is a cumulative interest. This interest started in a small way and developed through the home economist. I am greatly impressed with the number of people who are actively engaged in nutritional education of the people—not only in cities but in sparsely settled sections. It is even more important that the teachers in high schools and grade schools sometimes are teaching smaller children in matters of nutrition. When I was a boy they had none of that so I grew up eating what came along. Today children cannot grow up that way. In a great many schools, which is as it should be, teachers are drilling children in nutrition.

Dr. W. T. Swingle: Can you tell us some of the market conditions in foreign countries?

Mr. Olds: I found while abroad last summer attending an international conference of engineers that outside of Germany the United States is the only nation in the world that has any conception of engineering data as it applies to marketing.

Question: How is the Canadian market?

Mr. Olds: The Canadian market is not so good. They use about the same quantity of dates as England. There is no duty into Canada. The British labor conditions and the British surplus of dates results in cheap bulk dates and cheaper low grade packages, which makes it an unattractive market as long as buying power is so low.

Dr. Swingle: What about the increase in the consumption of seeded dates?

Mr. Olds: About five years ago our sales department started selling the idea of seeding dates to our factory managers. We put in every communication, "Dates must be pitted." Two years later they really took steps to bring about pitting commercially. We tried many machines without great success. They were not satisfactory — they either took too much meat with the seed, or were so slow in operation that the labor cost was excessive. So we hand pitted. Today we are hand pitting at home and importing a great many hand-pitted dates. We have recently developed our own pitting machine. This machine will pit five times as fast as a hand pitter and without as much waste. From a distribution standpoint we thought pitting would tie in very closely with the fruit confection development which has been characteristic. If one thing held back dates it was the difficulty of hand picking the pits. If dates were eaten as a confection, you have to provide a separate receptable for pits. If we could get rid of the pits we can overcome this. We shall advertise pitted dates and have brought pressure to

bear on distributors. Pitted dates were the first to have the double waxed paper pack, which was necessary to conserve the quality of freshness and moisture.

We have checked on distributors selling dates. A. and P. are our largest distributors. Last year they sold more unpitted and pitted dates than any other house. We have found that every single warehouse which had given a good break to pitted packages showed an increase. Warehouses which had not showed a satisfactory increase or in some few cases had lost were those which had not pushed pitted dates. We accredited the increased sales to the fact that they had given the pitted packages a good break.

Mr. E. Braunton: Do you pasteurize your dates.

Mr. Olds: All of the Dromedary dates. We do not practice pasteurization to protect Dromedary dates from worms. Pasteurization is for sterilization, or destruction of bacteria. We think your Los Angeles climate makes produce particularly susceptible to worms and weevils in retail stores. We have again and again in the past examined packages where we thought it impossible for worms to have gone out in the packages and we have almost always been able to find holes in the wrapping paper. We cannot protect a package permanently.

It might be well to say what we mean by pasteurization. The United States Department of Agriculture representatives have examined our machinery and gone through our laboratories both before and after our pasteurization process in order to see if we are mis-using the word. We wanted the backing of the United States Department of Agriculture and we have it. We have letters from different milk companies in most of the states. Some have been very cooperative and others have been very suspicious, and seemed to think we were mis-using a word which they had pre-empted. Our buyers have thought it was a "gag." We have been able to settle all the milk companies' doubts by letting them go to the factory or reading the experiments on which our work is based. They all say we are spreading the meaning of the word "pasteurization" and that we are helping the milk business.

Regarding the actual process, we may say that the entire date is subjected to a temperature of approximately 145 degrees for a period of more than one-half hour. Proper humidity conditions, of course, are as essential as heat in sterilization. We keep our exact process a secret because we have spent a lot of money developing the process and perfecting the machinery. We know our competitors have not been able to steal our process or copy our machinery as yet. We have the results of our advertising stolen. We do not resent it, it is to be expected. But in the case of our pasteurization, we have taken our pack out of the class of those of our competitors and I think we are justified in keeping the process secret.

Question: Can you figure on a per capita consumption increase in Southern Europe?

Mr. Olds: Per capita figures are not significant there. The average Latin is a very poor consumer of dates. Italians, Greeks and French people are poor consumers. A large percentage of increase in our population is from the Latin races. We should seek the western countries as outlets or northern Europe in figuring on future increase in per capita consumption.

Progress of Parlatoria Date Scale Eradication

By B. L. Boyden, Senior Entomologist, Plant Quarantine and Control, U. S. Experiment Station, Indio, California

THE Parlatoria date scale is a very small insect which feeds on the foliage and fruit of the date palm. To the naked eye, the female scale appears as a black speck with a white margin; the male, smaller, more narrow, and entirely white. This visible portion of the Parlatoria scale is a protective covering and underneath it is the soft bodied insect itself.

The female lays eggs which remain under the scale until hatched. The insect, when hatched, has legs but no wings. The young female emerges from the scale and crawls around for a short time, probably not more than two or three days. When it finds a suitable place it inserts its beak into the plant tissue and remains stationary for the remainder of its life. The young male follows the same procedure but when it is mature emerges from its covering, mates, and dies.

The damage to the palm caused by the Parlatoria scale is due to their sucking the juices from the foliage and by their presence on the fruit. The damage done by one of these tiny insects is slight but if an infestation is allowed to develop unmolested, the leaves and fruit will become encrusted with scale, causing serious damage to the palm and loss of fruit.

This pest was introduced on the first importations of date offshoots and was early recognized as a serious pest. R. H. Forbes states in Bulletin No. 56 of the Arizona Experiment Station, issued in 1907, "Parlatoria Blanchardi, when once established, spreads rapidly, damages the foliage of the date palm, and renders the fruit unmarketable, being, therefore, a serious menace to the industrial future of the tree under our climatic and cultural conditions."

Attempts were made to eradicate the insect by spraying and fumigation from 1890 to 1905 with little success. In addition to the difficulty of getting 100% kill on the exposed portion of the palm, many of the insects would settle on the leaf bases well below the protecting fiber. About this time a new method was tried in Arizona, which seemed to be successful on the individual palm. The palm was completely defoliated, leaving only the protected bud and the fiber cut back, exposing the scale on the leaf bases; the flame of a gasoline blow torch was then passed over the surface of the palm.

Using defoliation and torching as the basis, a campaign for the complete eradication of the Parlatoria scale in Arizona was begun and, later, in the date growing areas of California. Considerable progress was made, many infested properties were cleaned up, and by the spring of 1927, the pest seemed under control. That fall, however, several new infestations were found and

those interested in the date industry became quite alarmed concerning the situation. Congress voted $25,000 to meet the emergency.

With the additional funds, eradication work was continued in the infested gardens and a study of the entire situation begun. From a hasty survey of the entire area it was found that there were approximately 140,000 palms in the Coachella Valley, 33,000 in the Salt River Valley, 32,000 in the Imperial Valley, 20,000 around Yuma, and a few thousand in the Rio Grande Valley. In addition to this there were a few date palms in various localities in the Southwest outside the date growing areas.

In the Coachella Valley the plantings were in an area about 10 miles wide and 22 miles long and infestations severe enough to be considered centers of spread had been found at various points in the Valley. In the Imperial Valley the plantings were distributed over a large area with very few commercial plantings, most of the palms being ornamental or abandoned seedlings. Many heavy infestations of long standing were found in this area. In the Salt River Valley and at Yuma also the conditions were similar to those in the Imperial Valley but the percentage of commercial palms was greater and the number of infested palms much less and the infested areas smaller.

The first question to be answered was, "Should the eradication work be continued or should it be abandoned and control substituted?" Eradication as you know, means the killing of the last insect, making reinfestation impossible except in the case of reintroduction from outside sources. Control means, keeping the insect in such small numbers that the production of marketable fruit is possible.

Eradication, where feasible, is of course more desirable as it does away with the yearly expense of control. The main facts to be determined were, first, was eradication possible; second, if possible, would the cost of eradication and loss to the individual growers be justified by the results obtained.

Study of the results of the survey and past work indicated:

That the Parlatoria scale was a serious pest of the date palm.

That control would probably be difficult and expensive by any known method.

That the known hosts of the Parlatoria scale in the date growing areas were date and closely allied palms, the fan palm not included.

That the scale was known to occur in a comparatively limited area.

That the dissemination of the scale was comparatively slow.

That chance of spread from an infested palm increases proportionally to the intensity of the infestation and decreases proportionally with the distance of the adjacent palms.

That the scale could be eradicated from individual palms.

That under the existing conditions, with adequate inspection, followed by prompt treatment, infestations could be located and eliminated before they developed into centers of spread to infest surrounding plantings.

That in the infested areas there were thousands of palms in abandoned or neglected seedling plantings difficult or impossible to inspect which would be a menace to eradication or control.

That to carry an eradication campaign to a successful conclusion a much larger annual appropriation was necessary than had been available in the past.

That if such a campaign were to be successful full cooperation must be had between the growers and the Federal and State agencies concerned.

That prompt action was necessary as the palms were rapidly increasing in height and many offshoots were being set each year, rapidly increasing the cost of inspection and increasing the facility of spread of the insect by more continuous plantings.

The Date Growers' Pest Control Committee, which had been in close touch with the work, called a meeting in Riverside, California, September 24, 1928, at which meeting the Assistant Director of Agriculture of the California Department of Agriculture, the State Entomologist of Arizona, and Col. Dale Bumstead, a prominent Arizona date grower, were present. The entire matter was discussed and it was decided that eradication was feasible and desirable and it was recommended that the two states concerned, the growers, and the Plant Quarantine and Control Administration should cooperate in a vigorous campaign until the scale was eradicated or until eradication seemed hopeless.

The funds available for the fiscal year beginning July 1, 1928, were entirely inadequate and it was impossible to obtain either State or Federal appropriation at that time as neither State Legislatures or Congress was in session. In December, however, the Governor of California released $25,000 from his emergency fund to carry the work until the legislative bodies had an opportunity to appropriate the necessary funds.

Later, the State of California appropriated an additional $25,000 for the biennium beginning July 1, 1929, Congress appropriated $86,700 for the year beginning July 1, 1929, and the State of Arizona $20,000 for the biennium. While the Federal Agricultural Appropriation Bill for the next fiscal year has not yet been passed, it is quite probable that our funds for the next fiscal year will be adequate. From the results of this summer's work, we will, I hope, be able to estimate fairly accurately the additional funds which will be necessary to carry the project to its conclusion.

As I have mentioned, a survey or hasty inspection was made of the date growing area in the Coachella Valley during the first six months of 1929. Reports were made on each planting inspected, giving the owner's name, location of the property, number and age of the palms, and a brief description of the property. From these reports, the locations of all plantings were mapped. Each planting was given a number and a tack carrying a corresponding number was placed in a large wall map of the Valley. The infested properties, non-infested, previously infested, and the centers of spread were designated by different colored tacks.

Taking the longest distance the scale had been known to spread, as indicated by the map, for a radius and the heavy infestations as centers, an infested area was marked out. This infested area extended somewhat for safety, was divided into districts for convenience in planning inspection. The territory outside the infested area was also divided into districts.

The properties within each district were listed under two heads, scouting and routine. The properties listed under the head, "Routine," were those which required more than two one-man-days for a careful inspection. These properties are inspected by squads of five or more men. The properties requiring less than two one-man-days are inspected by scout-inspectors, working singly or in pairs.

From the survey it was quite evi-

dent that the funds available for the fiscal year beginning July 1, 1928, were inadequate and the work was planned accordingly. With only 12 full-time inspectors available for both California and Arizona, a careful follow-up inspection of the Valley was impossible so work during the summer was concentrated on the known infested properties with some hurried inspections of adjacent properties.

Additional funds were made available about the first of the calendar year 1929 and additional inspectors were hired and trained as soon as possible. During the first six months of 1929 the size and efficiency of the inspection force increased and the scope and intensity of inspection increased in proportion. In July of that year we began a leaf-by-leaf inspection of the entire infested area and also the High School and Indio Heights districts, which adjoin this area. This was completed late in October. Inspection for the remainder of the year was limited, for the most part, to the infested properties.

Beginning this year, the Indian Wells, Dos Palms, and Oasis districts were carefully covered in addition to the work in the infested gardens and another careful leaf-by-leaf inspection of the infested area has been started and will be completed some time this month.

Eradication work in the date growing areas outside the Coachella Valley has been carried on in the same manner, in fact, the entire work is considered as a single project. The plantings in these areas, however, are mostly small and the men permanently stationed there do scouting work almost entirely and the routine inspection in the larger plantings is carried on by squads of routine inspectors sent from the Coachella Valley.

The two fundamental operations in the eradication work are inspection to locate the scale and treatment to eliminate the scale on the infested palms when found.

The standard treatment is defoliation and torching. The entire foliage of the palm is removed and the fiber covering the leaf bases is split and pullel back to expose all scale. The flame of a gasoline torch is then run over the exposed surface. While a single treatment is ordinarily effective in eliminating the scale, in many cases, especially in the infestations of long standing, all the scale behind the fiber is not killed by the first treatment and additional treatments must be given.

Before the scale can be killed, however, it must be found and if our campaign is to be a success we must locate and treat the infested palms before there is any great danger of spread. To clean an infested garden the individual infested palms must be located and treated before the scale spreads to adjoining palms.

If inspection were perfect, we could make one survey of the date growing area, treat the palms found infested, watch those palms until we were sure that there would be no recurrence and then would be through. Unfortunately, inspection is not perfect. In the first place, one careful survey will not locate all the palms. It is quite probable that there are yet abandoned palms overgrown with desert brush in the Coachella Valley or dooryard plantings in the City of Phoenix overlooked by our scout inspectors. We are working on the theory that the last scale will be on the last palm located, so systematic scouting will be carried on until the project is completed.

After the palms are located it is quite possible to overlook light infestations and under some conditions those that are not so light. In the Coachella Valley in 1928 there were thousands of palms in abandoned plantings which were very difficult to inspect. Some were in unthinned nursery rows, some in garden formation bushy with offshoots and dead leaves, and some so engulfed in mesquite and other desert brush that approach, let alone inspection, was difficult. As practically all these palms were of no value, we dug up and destroyed most of them in the infested area with the consent of the owners. Since January, 1929, we have destroyed over 14,000 valueless palms in infested plantings and over 21,000 in other plantings in the infested areas. By July we hope to have all of them removed or in such condition that they can be properly inspected.

In commercial gardens conditions influencing the efficiency of inspection vary. In unpruned gardens with many offshoots, infestations are more liable to be overlooked than in those which are pruned high and from which the offshoots have been removed. Therefore, in an infested garden with a large amount of foliage, the clean-up period is likely to be longer and more palms involved.

The height of the palms also influences to some extent the time required to clean up a garden and to a larger extent the time required for inspection. A great deal of the inspection is done from 12 to 20 foot step ladders. Some palms are so high that inspection of all the leaves is impossible from the top of a 20-foot ladder. Inspection was tried from straight extension ladders and also from the top of a 20-foot ladder placed on a truck. Neither proved satisfactory. Our inspection foreman conceived the idea of a tower to be fastened to the body of a truck with an inspection platform which could be adjusted to the height of the larger palms. This idea was worked out so that the tallest palm in the Valley can now be carefully inspected and in about the same time that is required for 20-foot ladder work.

In addition to the mechanical factors which influence inspection, the human element must also be considered. Routine inspection is slow, monotonous work. The entire surface of the foliage of each palm must be examined carefully, seeking insects the size of pin heads. Keeping up this careful scrutiny day after day even under the most favorable conditions is difficult especially when weeks go by without finding scale. During the summer months with the temperature well over 110 degrees and with myriads of gnats buzzing in his eyes, the inspector's task is not the easiest and it is to be expected that a light infestation may be overlooked occasionally.

While there are many factors that make eradication of the Parlatoria scale difficult, there are others which offset them. The color of the scale makes it stand out on the green background of the leaf and the trained eye of an experienced inspector detects it readily. The physical make-up of the palm exposes a large percentage of its green tissue to the glance of the inspector, a much larger percentage than the citrus tree, for instance, with its multitude of leaves growing at various angles.

Because of the slow spread of the scale from palm to palm the infestation may increase to a point where it would be difficult to overlook in a careful inspection before a great number of palms are infested. In fact, a palm may have quite a number of scales on it and there be no spread.

Considering all angles of the problem, it seems quite probable that if careful systematic inspection is continued for a reasonable length of time, complete eradication will result. In the year 1927, 892 palms

were found infested on 22 properties, 11 of these were new infestations and 7 severe enough to be classed as centers of spread. In 1928, 1,568 infested palms were found infested on 22 properties, 6 of them new infestations, and 2 severe enough to be classed as centers of spread. In 1929, 579 infested palms were found on 32 properties, 17 of them new, and 2 severe enough to be classed as centers of spread.

During the three years scale was found on 45 properties. On 28 of these we feel sure that the scale has been definitely eradicated; on 10 we may find an occasional infested palm, and while scale is being found each inspection on the remaining 7 properties, there is a decided decrease in number each time. In connection with this, it must be remembered that funds would not permit a survey of the Valley until 1928 and a careful leaf-by-leaf inspection of the entire area was not made until the last six months of 1929.

The last centers of spread effecting the Indio and Coachella districts were found during the fall of 1927; in the Thermal and Mecca districts early in 1928; in the Arabia district in 1929; and in the Martinez district in July, 1929. No heavy infestations were found in the West Side district but these plantings may be effected by those in the Arabia district. While the High School, Indian Wells, Oasis, and Dos Palms districts are probably safe from the direct spread of scale from heavy infestations, there is always the chance that the scale may be brought in on offshoots or pollen. There is a slight chance of direct spread to the Indio Heights district and also the chance of accidental introduction.

The present status of the eradication project is very encouraging. In the Salt River Valley a survey of the entire valley was made in 1928 and followed by more careful inspections. The commercial plantings have been carefully inspected from time to time by routine inspectors from the Coachella Valley. At present there are three known infestations in the Phoenix area involving a total planting of 237 dooryard palms. No infested palms have been found in the commercial gardens.

In the Yuma district the City of Yuma is the only known infestation. The palms in the city have been inspected several times during the past year and occasional inspections made of the commercial gardens in that area. A complete survey of the entire district was made during the past winter. Three ornamental palms have been found infested there since July 1, 1928.

In the Imperial Valley a survey was made of the entire area in 1928. Scattered infestations were found in the southern part. During 1929, 165 infested palms were found on 54 properties. Most of these palms were of no value and were destroyed with the consent of the owners. Systematic inspection is being carried on and the number of infested palms found is being reduced materially.

In the Coachella Valley we have 10 properties which may or may not show scale during the present year and 7 are consistently showing scale but in steadily decreasing numbers.

We have 30 experienced inspectors in the Coachella Valley, 6 in Arizona, and 2 in Imperial Valley, more than three times as many as we had in July, 1928. During this year we expect to clean up most of the properties now known to be infested. We also expect to find some new infestations resulting from past heavy infestations. We do not expect to find any severe enough to be classed as centers of spread and feel confident that the situation will show steady improvement until the last infested palm is cleaned.

Mineral Nutrition of the Date Palm

By Dr. A. R. C. Haas, Citrus Experiment Station, Riverside, California

VERY little is known in regard to the mineral nutrition of the date palm. Those interested in the culture of the date palm have had to consider first of all the factors that seemed to them to be of the greatest importance; for example, climate, propagation, water supply, varieties, curing, processing, and the marketing of the fruit. The date palm appeared to get along well, so long as it had an ample supply of irrigation water of fairly good quality, fair drainage and sufficient heat units.

There is a considerable knowledge of the relation of saline irrigation water and salts in the soil with the growth and fruitfulness of the date palm in this country and abroad. Dr. Swingle has pointed out that the date palm is able to grow in soils containing 3 per cent of alkali salts (30,000 parts per million) and irrigated with brackish water containing 0.6 per cent of alkali salts (6,000 parts per million). Under such conditions growth is no doubt retarded. He mentions the disease called "Mez-noon" which results from excessive alkali.

It is claimed that a certain amount of salt in the soil is beneficial to the growth of the date palm, although, as yet, it has not been proven. It is therefore unknown whether the supposed effect of salt is due to the sodium, or to the chlorine, or to both sodium and chlorine.

As the date palm is monocotyledonous it may be of interest to note the effects of common rock salt on asparagus. Dr. Rudolphs found that when weeds were kept down by hand on all plots and applications of salt were made at the rate of 150, 300, and 500 pounds per acre with the manure, on two-year-old asparagus plots the total lengths per plant were 21.1, 28.6, and 38.7 per cent greater, respectively, than check plots; and that on eleven-year-old plants the total lengths per plant were 2.1, 11.7, and 25.9 per cent greater, respectively, than on check plots. I have heard it said that the water used in the Coachella Valley is of excellent quality and it might be profitable if such a salt experiment were tried out on the date palm.

From reading the various papers given in the past at the annual Date Growers' Institutes, I gained the impression that some years ago it was found that date palms were distinctly benefited by fertilization. Then came the use of cover crops, barnyard manure, and commercial fertilizer. What elements or ions does the date palm require in order to be commercially profitable?

Citrus, especially grapefruit, grows side by side with the date palm in the Coachella Valley and when we consider the needs of the date palm we naturally have citrus fertiiization in mind as our guide. We are there-

by making the assumption that they both have similar nutrient requirements. Citrus has been considered a good indicator plant as to whether a site was suitable for the growth of the date palm. In some cases they have been interplanted among diseased date palms in the hope that if palms were diseased, the citrus might also show some effects from which a diagnosis might be possible. It may be stated here that at the Institute meeting in 1927 a report was given of fertilizer trials on date palms in three gardens. It interested me much by reading the proceedings of the previous Date Institutes to learn that some growers fertilize very heavily with barnyard manure to which some add large amounts of potash or phosphorus or both. At the meeting in 1925 it was mentioned that the date palm is fertilized with water, meaning that an abundance of water is all that is necessary, a view to which only a few, if any, will now subscribe. The presence of fresh water calcium carbonate shells is taken as an encouraging sign of good soil and the hope is to be able to set this slowly dissolving calcium free more rapidly by the carbonic acid produced by the turned-under cover crops. Mature normal citrus leaves have been found to absorb very large amounts of calcium and very little potash; roughly say that the ash contains about 35 per cent of calcium and about 5 per cent of potassium. When the leaves contain too little calcium and too much potash, a condition of "mottle-leaf" exists. Does the composition of good date pinnae resemble more those of good or mottled citrus leaves?

What have we in the case of the pinnae of the date palm? Outside of my own results, I have never known the composition of date pinnae, except for a few analyses that were reported for Dr. Mason at the Date Institute in 1928. Dr. Mason was interested in finding out when the old fronds of the date palm were mature or past maturity for the purpose of knowing when the fronds might most advantageously be pruned from the palm. The outstanding point of interest to myself, as well as to several growers near me, was that the silica values appeared extremely high; so high in fact that some doubted that the sand or dirt had been entirely removed from the pinnae before they were analyzed. My results, I am glad to say, are in harmony with those of Dr. Mason.

Your County Agent, Mr. Winslow, persuaded me to take a day off and see the wonderful Coachella Valley and then proceeded to show me not only the better date gardens, but also the increasing acreage of palms that are in a state of severe decline. The palms had grown to various sizes before the decline became evident. As a visitor in the Valley for the first time, I could not help noting the absence of any paint applied where fronds were cut off. Doctors Fawcett and Klotz have been taking the view that the decline may be due to a fungus, or that the growth of the fungus is permitted as a consequence of the decline. Cause and effect have not as yet been established. Until I know to the contrary that a disease is due to an organism or a virus, I always assume that it may be a nutritional or physiological disturbance. Dr. Klotz and I purposely have had different goals in mind in this work, but nevertheless we have cooperated to the fullest extent whenever it facilitated matters to do so.

With the aid of Mr. Winslow I collected fronds from two excellent and four declining Deglet Noor date palms. Care was taken to obtain the good fronds from gardens in which no decline was visible. The analytical results were so encouraging that with the aid of Mr. R. H. Postlethwaite, additional Deglet Noor fronds were received which increased the number of the samples to about twenty-five. To these samples were added fronds from healthy and declining Cocos Plumosa plants for which I have to thank Mr. J. G. France, County Agent of San Diego County. In some cases roots were obtained, but the difficulty of removing adhering material from them, makes their analysis of doubtful value. Although I am aware that my subject concerns only the date palm, I feel that you will permit the digression to that of Cocos plumosa because it was the material that first gave me the desire to probe deeper into the nutrition of the palm tree.

In the case of the Cocos plumosa leaves it was found among other things that the total calcium in the dry matter of the leaves was 0.60 per cent for the good and 1.46 per cent for the bad leaves. The total potassium was found to be 1.23 per cent in the case of the dry matter of the good leaves and 0.97 per cent in the case of the bad leaves. The total nitrogen in the dry matter of the good leaves was 2.11 per cent and for the bad leaves 1.66 per cent. The total chlorine in the dry matter of the good leaves was 0.56 per cent and in that of the bad leaves was 0.35 per cent. In brief, therefore, the dry matter of the good Cocos plumosa leaves was higher in total nitrogen, total chlorine, and total potassium, but lower in total calcium than the dry matter of the bad leaves. The total sulfur content (which includes sulphates and organic sulfur was practically the same in both cases. The total phosphorus was least in the case of the good plants.

It is possible that good Cocos plumosa leaves normally contain more chlorine within certain wide limits than bad leaves. The bad leaves were deficient in potassium and nitrogen, but contained larger percentages of calcium than good leaves. We are confronted with the question as to whether or not too large a concentration of calcium and too low a concentration of potassium in the leaves of Cocos plumosa is injurious. Normal mature citrus leaves have relatively large concentrations of calcium and low concentrations of potassium. It might be possible, therefore, that just because citrus may do well under certain soil conditions is no guarantee that Cocos plumosa will behave similarly.

Let us proceed, however, to the date palm. The results of the analyses of twenty-five samples of pinnae have shown several points of interest. When samples of the finely ground dry pinnae, that were carefully wiped free of adhering dust, were dried at about 70 degrees C. and placed in white porcelain dishes, it was found that only the samples from the good fronds retained a dark green color. The samples from the fronds that were in the most severe decline were the yellowest of all. Several disinterested people placed the samples in the same order as described. It may be mentioned that it was impossible to guess by examining the fronds from good and bad palms as to the class of palms from which they were secured. All samples consequently were labelled on a cut surface at the base of the fronds. From my investigations on trees in general, including date palms, I have found that the analysis of what appears to be a good palm standing in a garden in close proximity to numerous bad palms may not show any appreciable difference from that of the bad palms. This means that the decline is one of degree and that the better looking palm may go backward when all the conditions of the disease are fulfilled. It was found to be the better practice to secure the good or control fronds from gardens free of the decline.

In brief and in general the pinnae of the good fronds from gardens showing no decline contained the higher percentages of total nitrogen and potassium in their dry matter, but lower percentages of calcium, precisely as was found for the Cocos plumosa pinnae. It is very striking that as the percentage of potassium increased in the better pinnae, the percentage of calcium decreased. Through the kindness of one of your date growers, I was given dates from good and from declining palms. The following are some of the results obtained upon analyses of the pulp and the seeds separately:

Per Cent of the Dry Matter

	Good Date Pulp	Bad Date Pulp	Good Date Seed	Bad Date Seed
Potassium	1.04	0.89	0.28	0.37
Calcium	0.10	0.09	0.04	0.05
Magnesium	0.08	0.10	0.14	0.11
Acid Sol. Ash	3.34	2.54	1.03	1.36

It will be seen that considerable potassium is lost from the tree during the fruiting process, the amount being about ten times that of calcium, and this loss is augmented by the removal of old fronds and disposing of their ash elsewhere than under the palm.

The composition of date pinnae is somewhat the reverse of that of citrus leaves. Good citrus leaves are richer in calcium than mottled citrus leaves, while good pinnae are poorer in calcium than are bad pinnae. Good citrus leaves are lower in potassium than mottled citrus leaves, while good pinnae are higher in potassium than are bad pinnae.

In view of these results should we expect date gardens that are interplanted with citrus, especially grapefruit, to be interplanted with the best tree indicator for a relatively too high a calcium nutrition and a relatively too low a potassium nutrition of date pinnae? Might not the prune tree, or tomato, or other likewise fairly sensitive plants as regards potassium nutrition be more suggestive? Perhaps it were better if we did not increase the calcium in the soil solution, but rather the potassium.

May I here take occasion to warn growers against being hurried into the idea that all they have to do is to add copious amounts of potash to the soil. Some people might welcome such a suggestion, but for the present, a few trials, such as a few individuals and the Citrus Experiment Station, are now carrying out, are sufficient to test such an hypothesis. When we add calcium to a soil or bring into solution calcium from the calcium carbonate shells, does not the calcium in part set free some potassium among other elements? And when we add potassium to a soil, does not the potassium in part set free calcium among other elements? Caution, therefore, is essential before giving any advice or suggestions regarding a soil program, because soils are complex media and may be far from uniform. It should be stated that the composition of the pinnae may be either the result of the decline or the decline may be the result of the composition. Cause and effect have not been distinguished as yet.

Professor R. W. Hodgson, at the meeting in 1925, mentioned that "soil analysis does not give us much help in our fertilizer problems." His statement was correct for the time at which it was written. With the newer attacks on soil problems, this statement may soon require revision. In this connection I may mention the excellent work of Professor P. L. Hubbard who, upon analyzing samples of soil obtained in close proximity to good and bad date palms respectively, found among other things that a 1:1 water extract of such soils showed a higher concentration of potasium in the case of the soil obtained near the good palms. It is of interest further that when potassium was added to the soils, a 1:1 water extract showed that the soil from the proximity of the good palms fixed less of the potassium that was added than in the case of the other soil. The soil therefore may be found to be just as important for the growth of the date palm as the climate and other factors.

The ash of the dry matter of the pinnae ranged from about 12 to 29 per cent. The acid soluble ash as a percentage of the dry matter was about 2 to 4 per cent, the acid insoluble ash therefore ranged from about 10 to 25 per cent of the dry matter. It was found that practically all of this acid insoluble ash was silica. To analyze the ash of pinnae, therefore, is like analyzing a sand pile. Perhaps they are as close as we can approach with living plants the world famous hand-made glass plants that are exhibited at Harvard University Museum.

Analyses of samples of pinnae as far as I have progressed, have shown a larger concentration of chlorine in the pinnae of good fronds. No significant differences as yet have been found in the total sulfur or phosphorus. About 80 per cent of the calcium in the dry matter of pinnae is water soluble, while over 90 per cent of the potassium is water soluble. It might be of interest to mention here that the ash of the leaves of corn plants (which are also monocotyledonous plants) have been shown by Schweitzer to contain about 4 per cent lime and 31 per cent potash.

When copper sulphate was applied to the soil about a declining date palm and the salt carried down by the irrigation water, it was found that the analysis of the pinnae of a frond cut off some months later, showed the same composition as pinnae of good fronds. Mr. Postlethwaite, who carried on the experiment, is inclined to the view that the palm is improving. What copper sulfate does to the soil or pinnae, no one knows. Its use in the case of exanthema of citrus in Florida and California is likewise in the stages of working with a lot of unknown factors, some of which I hope to attack. We do not know whether the copper is a required element for the pinnae, or whether its benefit, if any, is due to the destruction of a soil organism, toxin or virus. The pinnae might have requirements for small traces of elements not ordinarily considered at present in the nutrition of the palm. We now know that there are deficiency diseases as well as injuries due to excesses.

May I mention before closing that we have germinated some Deglet Noor seed in pure sand and have grown the seedlings in water cultures to which we have made certain additions or subtractions. The experiments are only of a preliminary nature thus far. If we add up to 6,000 parts per million of salt (NaCl) to Hoagland's culture solution, the growth of the seedlings is not appreciably affected If, however, we omit potassium, the tips of the rootlets become diseased. In contrast to the salt addition, if we add sufficient beryllium or glucinium to Hoagland's solution so as to give concentrations ranging from 1 to 20 parts per million, we find the effect to be one of extreme toxicity.

These preliminary results indicate that date pinnae are highly siliceous and that the pinnae of declining palms are deficient in nitrogen and potassium, but contain an excess of calcium as compared with the pinnae of healthy date palms; also, the pulp of dates from good date palms is richer in potassium than that of dates of declining palms. The use of copper sulfate has given thus far encouraging results. Small concentrations of certain elements may be essential to the normal healthy growth of the pinnae, whereas small concentrations of other elements may be decidedly toxic.

Notes On Processing and Packing Dates

By R. H. Postlethwaite, Consulting Engineer, Coachella

AS the date crop of the Coachella Valley is now around the one thousand ton mark, it seems in order for us to take stock of the future as succeeding years will provide a very rapid increase in the crop.

Fortunately the old, and sometimes rather strenuous, controversy over the variety question has settled down and from present indications some half dozen or so varieties seem to be accepted as the future commercial basis for the combined fruit crop.

As far as the packing end is concerned the varieties may be roughly divided into the Fruit Sugar or Soft Fruit Class, largely consisting of persian varieties as exemplified by the Khadhrawi and the, so-called, Sucrose date, largely consisting of Algerian varieties as exemplified by the Deglet Noor.

Before going into packing details it may be advisable to retrospect a few years and enumerate the theories actuating those who were instrumental in starting the commercial packing of dates. Three classifications will probably cover the ground. First, a small number generally packing a small quantity of seedling and standard variety of dates. These packers had neither the knowledge nor capital to put up a sound or insect-proof pack. The selling was mostly confined to wayside booths, if not infested with worms, the dates were eaten out of hand.

Except for the advertising injury to the industry this class of packing need not be considered seriously, as it is of relatively very small proportions and its own inherent weakness will slowly but surely abolish it.

The two remaining packing theories or "schools of thought," as they may be called, are worthy of serious consideration as the future success of the industry will largely depend upon a proper decision being made in the near future as to which one will be adopted when the annual crop largely exceeds the present output and really begins to make a dent in the date consumption of the country.

There does not seem to be much difference of opinion as to packing the Persian varieties. In nearly all cases these are treated so as to take them out of the perishable fruit class and place them in such condition that they will keep almost indefinitely without cold storage or artificial means of preservation.

With the Deglet Noor variety there is a sharp difference of opinion as to the correct way to handle the pack.

One theory and the one under which the largest number of Deglet Noor dates are now packed, is based on the belief that customers wish the date to be light colored, translucent and with high moisture content and thus very soft.

There is no dispute as to the beauty of such a date and undoubtedly many customers who have been educated to it, believe that it is a superior date, but there are many serious disadvantages to it. A limited quantity can always be sold for immediate consumption but it is the writer's opinion that when the output is much larger than at present the practice will lead to failure.

To elucidate the argument a short description of the life history of the Deglet Noor berry is required. When the berry first reaches its full size, it is green, just turning to light yellow with a total sugar content of 6% and a moisture content of 80%, the sucrose and fruit sugars are then approximately equal.

In the second stage the berry is yellow, just turning to pink and now has sucrose 23% and fruit sugar 7% or a total of 30% with a moisture content of 50%.

In the third stage the berry is pink turning to dark yellow and now has sucrose 35% and fruit sugar 12% or a total of 47% with 36% moisture.

When the berry is nearly ready to pick it is fully dark yellow with sucrose 42% and fruit sugar 13% or a total of 55% and a moisture content of 31%.

When the berry is ready to pick it is darker yellow or amber with a total sugar content of approximately 58% to 60% and a moisture content of 28% to 30%.

If the berry in this "ready to pick" stage is split open, it will show round the seed cavity a white substance which is cellulose or rag. This cellulose is often two-thirds the total thickness of the edible portion and comprises all of it at the Calyx end.

This cellulose, or unmade date meat, is very largely the cause of the light color of the berry; thus to have this light color it is essential that much of the edible portion be cellulose or rag.

To keep the softness, under the above theory deemed advisable, the moisture content must be 30% or over, therefore the total sugars in the berry do not exceed 60% which means that the date is in the perishable class and is not self preserving.

Dates shipped in this state are very nice and tasty, if eaten within a few days of packing, but if kept for any length of time are in imminent danger of fermenting and souring.

If kept under the usual cold storage conditions where no proper humidity control is exercised the dates become darker and even more susceptible to rapid deterioration after removal from the storage room.

Doubtless a certain amount of fruit as described can be packed and sold with safety if proper cold storage conditions are provided at the packing house or some central point and the retailer has cold storage facilities in which to keep the dates until sold to the consumer, who will presumably eat them within a few days.

As shown by the preceding typical analyses, most of the sugar in the Deglet Noor date, in its earlier stages, is in the form of sucrose or cane sugar and by many this is believed to be the cause of the rather distinct flavor of the date. It must, however, be conceded that due to enzymic action, possibly aided by a slight acidity, inversion of this sucrose into fruit sugar is constantly taking place, more or less rapidly, depending upon the temperature and moisture content of the berry.

Even at temperatures near zero this action probably takes place, but at a reduced speed.

A stable state approximating equal proportions of sucrose and fruit sugar will be finally reached.

From a selling standpoint, it does not seem to the writer that any stress should be placed upon the Deglet Noor being a sucrose or cane sugar date. Many health fanatics do not differentiate between highly refined cane sugar and sucrose in its natural state in the fruit with all its organizing salts intact.

It must be accepted as an axiom that inversion of sugar is constantly taking place and that if a date is packed or stored in the light colored soft stage previously described, it will become darker.

At the Institute meeting in 1926 a very able paper was read by Mr. L. Swingle and at that meeting the writer issued a word of warning against cold storage as generally carried out and subsequently experience has proved the correctness of that advice.

Let there be no misunderstanding on this point, Mr. Swingle plainly stated that humidity must be controlled as well as temperature.

This control, however, has not been exercised up to this time and therein lies the weakness of the present methods.

The proponents of the second theory or "school of thought" have not had so many Deglet Noor dates to pack but a sufficient quantity has been processed, packed and sold to convince the writer that the second theory is sound, and will furnish the key to the success of the industry, when the total pack largely exceeds the present output. This, of course, does not suggest that all the details of the methods are now perfected, but merely that a sound foundation has been laid on which to build improvements for the future.

This basic condition underlying the theory is: The main pack must consist of dates fully matured, with most of the rag or cellulose broken down into date meat; the tannin made insoluble; the sugar inversion carried to such a point as to bring the berry to a stable condition; moisture content brought to a point not greater than 25%.

Given these conditions dates of A and B grade can safely be packed and will keep without change for months under ordinary conditions.

A portion of the pack, varying with the demand, can be put out as perishable fruit for immediate consumption to suit a certain class of trade already developed.

Now as to the methods to be used to enable a Deglet Noor date to be put on the market at any time of year, with the certainty that it will neither ferment nor sour under any ordinary conditions of storage after leaving the packing plant.

In this connection it may be stated that a berry, in which the cellulose or rag has been broken down into date meat, does not dry out so readily as one in which the original rag is intact, moreover it will keep its moisture even under adverse conditions, if packed in air-tight containers.

The treatment required by the Deglet Noor date upon its delivery at the packing house varies according to climatic conditions.

Take the worst case first, such as the treatment required to save and make a commercial pack out of dates picked after the heavy rain October 4 and 5, 1925, when three inches of rain fell and many thousands of pounds were lost due to lack of knowledge and of the necessary mechanical appliances in the Valley.

The correct way to treat such dates, which were very sticky and soft when delivered to the packing house, is to wash them, then immediately place in a dehydrator at about 140 to 150 degrees for three or four hours to take out the excess moisture. They are then ready to go to the process rooms and after a short period the original rag is broken down and they are ready to pack either with or without further dehydration according to the moisture content.

The above is not theory but was actually done with over 90% saving of good commercial dates.

Fortunately, however, such severe conditions have only occurred one year since dates were grown in Coachella Valley.

Let us now consider the necessary equipment and methods for taking the Deglet Noor date out of the perishable fruit class and putting it into permanent form.

A normal season will show dates closely approximating the typical analyses already given together with the two extremes of very dry and very moist berries.

After passing through fumigation and the dry cleaning they should be graded for moisture condition. But a small percentage of the dates at this stage will require dehydration, the larger percentage may be placed directly in process rooms or storage rooms.

A typical efficient process and storage plant should consist of say six well insulated rooms all of which can be ventilated and must be subject to automatic control both of temperature and humidity. The coldest room should be held at 40 degrees F. and 45% to 50% humidity. Under these conditions dates would process very slowly and would gradually lose moisture and would, if soft and unmade when placed in the room, at the end of four to six months be ready to take out and pack.

This room could be considered as the long time storage room. If, however, these soft dates were required for early shipment they would be placed in a room with 90 degrees F. and 50% humidity and would be "made" in a week and after a short dehydration could be shipped.

Very dry dates would be placed in a room of 110 degrees with 70% humidity for 30 days and would by proper absorption of moisture be then ready to ship. These dates while not A grade, would be improved and made heavier and softer by the treatment.

Given a plant with six rooms and control of temperature and humidity with an extreme range from 40 degrees F. with 45% to 110 degrees F. with 75% humidity dates of various initial degrees of moisture and rag can be put into commercial form for early shipment or for shipment at six or nine months as required.

Air conditioning is a well known art and there is no difficulty in building such a plant and obtaining the result briefly stated above.

While there may be difference of opinion as to the attractiveness of a raw or unmade date and one which is properly processed and taken out of the perishable fruit class, there can be no difference of opinion as to the absolute damage to the industry if even one berry in a package is sour when opened by the consumer and danger of this is ever present when dates are packed with excessive moisture content.

DISCUSSION

Bryan Haywood: Mr. Postlethwaite alluded to the number of dates which he processed in 1925 or 1926. I think he had reference to some I sent him from my garden at that time. I gave him the worst of it. Those of you who went through that year will remember that the skin of the dates was turned up into little curlicues. I burned 9,000 pounds that year. The skin of these dates were all like that and they were a total loss. I sent 58 pounds to Mr. Postlethwaite and asked him to see what he could do with them. He sent me back out of the 58 pounds I sent him, 50 pounds of perfectly good dates. They were not, of course, smooth, and not perfect in appearance; but they were perfectly good, edible dates. Those dates are just as good today as they were the day he packed them. In fact, I have some of them in the car now, but I forgot to bring them in as I had intended.