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Date Growers' Institute

HELD IN

COACHELLA VALLEY

CALIFORNIA

APRIL 13, 1935

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Twelfth Annual

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Saturday, April 13th, 1935

THE OUTLOOK FOR THE DATE

By Dr. H. J. Webber, Citrus Experiment Station, Riverside, California

Introductory Remarks In Opening the Twelfth Annual Date Growers' Institute

IT GIVES ME great satisfaction to be chosen to preside at this opening session of your 12th Annual Institute. The Institute was organized to foster the extension of our knowledge of date culture. It has been of great service as a meeting place of growers for the exchange of ideas and for the presentation of the results of scientific research. Greater advance has been made here in the science of date culture than has been made elsewhere during four thousand years of culture.

At the Institute last year I emphasized this great achievement as a feature from which we should derive encouragement and inspiration. Unfortunately we meet again today with the industry still suffering in the strangling grip of the great depression. Is the depression in the date industry entirely a result of the general depression, or is the trouble deeper and peculiar to the industry itself?

Perhaps it is true that the industry has not been so successful as the pioneers in its establishment had reason to expect. This we may admit because the rainbow visions of a pioneer are rarely realized. We can now view the industry with a background of thirty years of experience. Is there anything we can discover by a background survey that may cause us to pause and revalue the brilliance of the pioneer vision? It is said that if one would make great discoveries, he must work like ———, "sugar tongs and tinderboxes" to lay up a store of information and charge the "subconscious mind" with experiences and then hie away to the open spaces and hunt or fish or play poker to allow the subconscious mind to dig up the discovery. This is indeed a method of making discoveries that would appeal to many. It has a real appeal to me. But, will the subconscious mind get busy and turn up the discovery? I confess that I have given this method, or at least the latter part of it, ample trial and should be able today to report to you great conclusions. Something seems to be at fault, however, and perhaps I did not fully carry out the first requisite of working like ———, "sugar tongs and tinderboxes" to properly charge the subconscious mind with facts. In any case I have to report that working my conscious mind as fully as I have been able to do I can discover no fundamental error in the conclusions of pioneer growers regarding this industry. Date growing after the experience of thirty years visioned in retrospect seems to me even more alluring and more worthy of development in this great valley than it did when I first came to know the industry twenty-two years ago.

With full cognizance of all our difficulties and the hard work we have had to give our alphabet to get the A. A. A., the F. E. R. A., the C. C. C., and so on to the XYZ's, I am sure that not one of us would question the fundamental and inherent greatness of our country. I am sure we all recognize our own country as the world's best market for our products. I am sure we all subscribe, with reasonable restrictions, to the policy of "America for Americans." I am sure we all have unimpaired confidence that we will finally blunder out of this depression.

What, then, is the view we get of the future of the date in America. Thirty years ago the pioneers started with an idea and a palm. We start today with a background of certain knowledge and developed groves, with thousands of palms of all known desirable varieties. The pioneers were confronted with a wilderness, isolation, uncertainty. We have a developed civilization, cities, schools, churches, good roads, autos, and airplanes to whisk us to high altitudes and cooling breezes. Our country is still sound, and our citizens still demand and use dates in far larger quantities than we can produce. We still in the large pursue a policy of protecting American industries against the influx of products produced in other countries with pauper labor. We still adhere in general to a policy of "equality and fair play" for all of our numerous industries. Can it be possible that holding such ideals the date industry will be permitted to languish and decline from a lack of that fostering protection that has been given to, and made other industries?

With the opening of the great Boulder Dam, millions of acres become available for agricultural development, which must be tilled if the great government expenditure is to be justified. What can possibly be grown on this land that will enable a settler to meet his obligations? On the few hundreds of acres that will be suitable for dates certainly no crop would seem to be more promising than dates in view of the value and desirability of the product and the fact that we now import the major part of the product used.

People are inclined to consider dates as a luxury, but their high food value indicates that they should be classed also with the important foods. They are very rich in sugar, and sugar is one of the products our country must import.

Let us review the food value of the date from the standpoint of acre production and compare it with wheat. The following are the averages of analyses of dates and of entire wheat flour as given by the U. S. Dept. of Agriculture (U. S. D. A. Office of Experiment Stations Bul. 28. 1896), in per cents of the total except for calories:

Crop	Refuse	Water	Protein	Fat	Carbohydrates	Ash	Calories per lb.
Dates	12	18.3	1.9	4.5	61.9	1.4	1,375
Entire wheat flour	0	12.1	14.2	1.9	70.6	1.2	1,660

For comparison of acre value of the product produced, let us assume a yield for wheat of 20 bushels per acre, which is considered a good yield and is much above the average. This would thus be 1,200 pounds per acre.

For the date, to make our case fair, let us assume a planting of palms 30x30 feet, which would give 48 trees per acre, the ordinary number, and assume a yield of only 100 pounds of dates per tree (which is certainly more common than yields of 20 bushels per acre of wheat), and we would have a yield of 4,800 pounds per acre of dates. On these estimates for dates and wheat there would be produced per acre the following quantities of important food elements:

Crop	Gross yield	Total pounds per acre Protein	Fat	Carbo-hydrates	Ash	Calories per acre
Dates	4,800	91	216	2,971	67	6,600,000
Wheat	1,200	170	23	847	14	1,992,000

Dates in acre production of important food elements far outyield wheat, the proportion being nearly three to one. Have we fully appreciated this? Large quantities of low-grade fruits are produced that are in general considered valueless. Some of these are already used in the manufacture of various products, but I can visualize a much expanded utilization. I have been told that American date growers use dates only as a luxury. One time I was marooned by a tropical hurricane for a week with a scarcity of foods except for an abundance of dates. The family of five ate date pancakes, date breakfast food, date salad with olive oil, date entree fried as meat with minced ham gravy, date pie for dessert, and "oh, boy," it was good!

We came out enthusiastic for a date diet. I am convinced that we have as yet but scratched the surface in estimating the value of dates.

Can such a crop fail in a great country like America? Perish the thought. The industry is certain to succeed and to develop to great proportions. Growers must tighten their belts and hang on. The reward of success cannot be long delayed.

Some Suggestions On Soil Management In Date Gardens

By Warren R. Schoonover, Extension Specialist in Citriculture
University of California

IT MAY appear to you growers that an insufficient amount of experimental work has been done to justify our suggesting a soil management program for date gardens. However, there are certain fundamental principles of soil management which apply to any permanent, deep-rooted crop. Certain cultural practices have very definite effects on the soil and must be carried out in the proper manner regardless of the nature of the crop being grown. It is true that certain details regarding application of these practices to growing of dates remain to be worked out, but there are a number of suggestions which can be made which have sufficient background in fundamental principle to be sound.

Soils have two important functions: (1) The soil serves as a reservoir in which available water may be stored for the palm to use over a period of time; (2) the soil serves as the principal source of raw materials which the palm uses in its growth process. Related to these two functions of the soil are the two fundamentals of soil management. They are: (1) the control of soil moisture; (2) maintenance of fertility.

The palm is not very much influenced by the particular methods a grower may use in carrying out the various soil management operations. The important thing is to so manage the soil that it will supply the entire root system of the palm with available moisture through the year and so that it will furnish the raw materials required for growth. We do not accomplish these two things by a single operation. There are ordinarily six practices which we utilize in soil management and we speak of them as the essential soil management practices. The sole purpose in carrying out the various practices is to overcome unfavorable conditions which would be likely to arise if one or more of the practices should be omitted. The various soil management practices should not be carried out according to any fixed rule but the operator should endeavor to figure out what unfavorable circumstances a particular practice can overcome and to what extent and at what time the practice should be utilized as a means of bettering conditions. We have only six important soil management operations: Irrigation, drainage, leaching, fertilization, cover-cropping, and tillage, each of which we shall discuss briefly.

1. **Irrigation.** This practice is for the purpose of overcoming drought. Every soil is capable of storing a definite amount of water which is available to the palm. The capacity of a particular soil is fixed by the size and arrangement of soil particles and there is no practical way for the grower to alter it. The storage capacity for available water varies from ½ gallon to 1½ gallons per cubic foot of soil. Sandy soils fall near the lower limit of storage capacity, and clay soils near the upper limit, with loam soils in between. The soil, like any reservoir of fixed capacity, can hold only a certain amount of water and you cannot store water in a reservoir which is already full. Neither can you store water in a soil which is already wet. It is apparent from certain data which we have on date irrigation, that growers do not realize the impossibility of storing water in soils which are already wet, and it is fairly common practice for growers to apply much larger amounts of water than can be stored in the root zone. Sometimes the water is applied when the storage reservoir in the soil is so nearly filled to capacity that only 10 or 15 per cent of the water which is applied is utilized by the palms. This practice may not be actually detrimental but it does result in unnecessary expense. The practice may be beneficial if harmful salts are leached out of the root zone but it may be detrimental owing to the leaching out of soluble plant nutrients. There is a sound principle of irrigation that applies to any crop, disregarding the necessity for occasional leaching, that water should not be applied

until a reasonably large proportion of the available moisture has been extracted from the soil, and then only enough water to replenish depletion. In other words, the problem is to restore all of the soil mass in the root zone to its full moisture-holding capacity without wasting water by run-off or deep percolation. Under ideal conditions, water could be applied with so high a degree of efficiency that nearly 80 per cent of the water would be used by the palms for transpiration. It is reasonable to try for a goal of 50 to 60 per cent effeciency rather than 15 to 30 per cent efficiency so often encountered. High efficiency of irrigation cannot be accomplished without using a soil auger or soil tube to determine the degree of dryness of the soil before irrigation and what becomes of the water which is applied.

2. **Drainage.** Drainage is of importance at the present time in only a few locations but all farmers in the Coachella Valley need to be thinking about drainage. It will become a very important problem when additional water is introduced from the Colorado River. Development of a water table usually causes an acute salt problem, but even in the absence of a salt problem drainage results in improvement of conditions because most plants do not thrive with their roots in free water. They do best in drained soil. Salt accumulation is always a problem in regions of low rainfall like the Coachella Valley. Drainage is therefore important as part of the means of preventing or renewing salt accumulations in the soil because the next practice, leaching, cannot be carried out without good drainage, either natural or artificial.

3. **Leaching.** Leaching is a practice which goes along with drainage. Its job is to remove harmful materials which may come in the irrigation water or which may have been present in the soil naturally. The water supply of the Coachella Valley at the present time is relatively pure, but there are individual properties where harmful amounts of salts are present in the soil and where leaching should be carried out at the present time. This is more important for some of the other crops than dates because the date is relatively salt tolerant. It is not too early, however, for date growers to begin to familiarize themselves with practical methods of soil leaching and be prepared to carry them out, because when the Colorado River water is introduced the salt problem will eventually become acute and leaching will have to be a regular practice.

4. **Fertilization.** It is the function of the soil to supply all of the raw materials used for growth. Certain soils which are lacking in fertility are unable to supply all of the raw materials in necessary quantities but no soil is so poor that it will fail to supply a fairly large share of these materials. It is not the function of the fertilizer to supply the elements which the tree or fruit takes from the soil. The function of the fertilizer is to supplement the supply coming from the soil where the soil is not able to perform its full duty. It is therefore difficult to make definite fertilizer recommendations because no two soils will fall down by the same amount in their ability to supply all the necessary materials, and the problem becomes further complicated due to difference in crops and difference in management. No faith should be placed in the so-called balanced fertilizer theory. It is true that the date, like every other plant, requires 13 or 14 elements which come from the soil, and these are utilized in certain proportions. However, the nature of the soil solution from which the plant takes its raw materials is determined mainly by the soil itself, and is only influenced to a small degree by materials which we apply. It is up to nature to determine the balance. We are only concerned with preventing a possible shortage of one or more of the important raw materials. I ask you to please notice that I have not used the words **plant food** in this discussion. Plants do not take foods from the soil. Plants manufacture foods in the leaves and these foods are then utilized for growth processes, fruit production, storage, etc. There is nothing in the growing of plants which is comparable with the feeding of animals which use manufactured foods. The plant takes only raw materials and the rate at which it can utilize these materials is in large measure determined by the rate of manufacture of foods in the leaves. We cannot stuff a carrot or a tree, or a lettuce plant, like we do a turkey, or a pig. We have, therefore, with permanent, deep-rooted crops, a problem of improving the soil mass as a whole, and we need to make local experiments and observations to determine what particular element or elements are likely to be deficient. Because such plants as trees and palms are deep-rooted and have a long-growing season, they apparently do not require as concentrated a soil solution with respect to most raw materials as do quick-growing, annual, herbaceous crops. It is therefore entirely practical to develop a certain amount of local experience with regard to possible fertilizer deficiencies by making fertilizer trials on small areas of cover-crops grown in the date gardens. Fertilizer trials with cover-crops are relatively simple and inexpensive to carry out. It cannot be said with any certainty that where a cover-crop responds to nitrogen or phosphate, or any other fertilizer material, that the palm will show response, but the very fact that the cover-crop shows a response indicates that a deficiency exists at least for a quick-growing plant, and that we may be approaching the time when if nothing is done a deficiency will exist for the palm.

5. **Cover-cropping.** There is not time to discuss the importance of organic matter but most observers feel that the maintenance of a supply of organic matter in the soil is the key to the maintenance of fertility. The bringing in of bulky organic fertilizer material is pretty expensive and it may be possible to meet the requirements almost completely through cover-crops grown on the land. The most important thing is to get a good tonnage of green material to turn under and to grow that material at a time when competition with the palm will not be serious. Local experience will have to be developed with regard to the best season for growing cover-crops, and with regard to the choice of plants which will make a reasonably good tonnage, considering the fact that they have to grow in partial shade.

6. **Tillage.** By tillage we mean to include all soil-stirring operations. Tillage is a practice designed, as already mentioned, to overcome unfavorable circumstances which are likely to arise unless the soil is stirred or which can be almost economically prevented by a soil-stirring operation rather than some other type of operation. Stirring the soil is usually harmful to its structure and no soil-stirring operation should be carried out unless the useful purpose produces a benefit greater than the damage done to the soil structure as a result of the operation. Therefore, each soil-stirring operation should be carefully considered with regard to the possible benefits, cost, etc. The most important function of tillage is control of weed competition. It is not necessary to have a weed-free farm and it is pretty expensive to do so, but weeds

should not be allowed to develop to the point where they are competitive with the palm for either moisture or raw materials.

Another important function of tillage is to prepare the land for distribution of water. Some works made out of earth are necessary to convey the water across the field. These works should preferably be ridges for all desert regions so as to permit flooding of the surface of the land. Flooding methods require good leveling of the land, and the making of ridges. The same ridges may be used for more than one irrigation.

Another important function of tillage is to mix organic matter such as manure or cover-crops with the surface soil. This material does not need to be mixed deeply but it is of more benefit if it decays in contact with soil particles instead of just on the surface. Whenever a soil-stirring operation is undertaken it should be at a time when the moisture content of the soil six inches under the surface is low enough so that the soil will crumble rather than pack. All tillage tools should be equipped with depth-control devices which will permit the shallowest operation consistent with doing a reasonably good job.

The benefits of reduced tillage are immediate and tangible. They are direct savings in cost, longer life of the tractor and tools, and finally, the less the soil is stirred, the better physical condition it will have.

In closing let me repeat that the various soil management operations are mere incidents in the production of a crop, to be carried on only when one is sure a real benefit will result.

INORGANIC COMPOSITION OF DATE FRUITS

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

THE inorganic content of the pulp of date fruits is of importance because of the loss of these constituents to the palm when the crop is picked. Ordinarily, interest is chiefly centered on the sugar content and on the type of sugar present, whether of the invert type as in the Halawy or Sayer varieties or of the cane sugar type as in the Deglet Noor variety.

A basis for the inorganic fertilization of gardens consists of the amount of inorganic constituents removed in the crop, that utilized in increasing the growth of the palm, and that for which the soil has competed with the palm by forming relatively insoluble compounds, and we might add to these the amount lost by soil drainage. The present preliminary data contribute to the phase of the problem of the loss of inorganic constituents in the crop. Symptoms of inorganic deficiencies in palms at present are unknown. The practice of artificially cutting down the natural crop production of palms by the cutting back and by the removal of whole fruit strands is designed to permit an adequate supply of inorganic constituents for a crop, the organic materials of which can be supplied with a liberal margin by the vegetative portions. The interruption of flow of these materials into the fruit by an inadequate water supply for the palms during periods of critical temperatures has often been considered a vital factor in the production of a crop of fruit of the desired tonnage that has turned out to be of decidedly inferior quality.

It is known that the Deglet Noor variety of date palm is susceptible to decline disease while others apparently are not affected (cf. Bliss (1). The inorganic content of the fruits of this variety are of added importance, for at present the assumption is made that date fruits of all varieties contain the same inorganic content. If chemical differ-

TABLE 1 (a)
Inorganic Constituents in Pulp (no seed or calyx)
In Dry Matter

Variety	Ash (per cent)	Calcium (per cent)	Magnesium (per cent)	Potassium (per cent)	Sodium (per cent)	Inorganic (ash) Phosphate (per cent)	Iron	Manganese	Copper
							parts per million		
Khadrawy	3.38	.106	.058	1.48	.39	.15	7	2.7	
Halawy	3.24	.108	.057	1.38	.34	.22	16	2.7	
"	2.95	.071	.082	1.27	.29	.31	26	3.6	
Zahidi	2.53	.090	.063	1.06	.26	.23	10	3.4	
Kustawy	2.35	.083	.051	1.00	.23	.22	15	3.1	
Barhee	2.28	.081	.061	.93	.19	.26	5	3.8	
			Healthy Palms						
Deglet Noor	2.49	.072	.062	1.07	.24	.27	12	2.8	
" "	2.44	.077	.059	1.07	.25	.25	6	1.9	
" "	2.22	.064	.058	.96	.21	.30	10	3.6	
" "	2.14	.056	.053	.93	.20	.23	9	2.9	
			Decline-Diseased Palms						
Deglet Noor	2.34	.080	.074	1.01	.24	.17	8	3.3	6.1
" "	2.15	.072	.072	.92	.20	.08	13	2.8	2.9
" "	2.35	.095	.071	.99	.25	.08	12	4.3	3.8

TABLE 1 (b)
Inorganic Constituents in Pulp (no seed or calyx)
In Ash (per cent)

Variety	Calcium	Magnesium	Potassium	Sodium	Phosphate
Khadrawy	3.12	1.72	43.68	11.67	4.38
Halawy	3.33	1.78	42.57	10.61	6.70
"	2.41	2.77	43.17	9.67	10.53
Zahidi	3.56	2.48	42.09	10.17	9.01
Kustawy	3.62	2.23	43.37	9.81	9.52
Barhee	3.54	2.68	40.90	8.33	11.24
		Healthy Palms			
Deglet Noor	2.91	2.49	43.12	9.55	10.73
" "	3.15	2.42	43.79	10.41	10.34
" "	2.91	2.60	43.47	9.41	13.36
" "	2.59	2.51	43.26	9.22	10.70
		Decline-Diseased Palms			
Deglet Noor	3.41	3.17	43.04	10.40	7.54
" "	3.33	3.33	42.81	9.45	3.53
" "	4.03	3.02	41.98	10.80	3.42

TABLE 1 (c)

Inorganic Constituents in Pulp (no seed or calyx)

Grams per Average Fruit (seed and calyx removed)

Variety	Ash	Calcium x 100	Magnesium x 100	Potassium x 10	Sodium x 10	Inorganic (ash) Phosphate x 10	Iron x 10,000	Manganese x 10,000	Copper x 10,000
Khadrawy	.0338	.105	.058	.1475	.0390	.0148	.07	.03	
Halawy	.1610	.537	.286	.6856	.1710	.1079	.82	.14	
"	.1315	.317	.364	.1384	.1270	.1384	.25	.16	
Zahidi	.1478	.526	.366	.6220	.1510	.1331	.56	.20	
Kustawy	.0761	.275	.170	.3298	.0720	.0724	.35	.10	
Barhee	.1678	.594	.451	.6862	.1398	.1886	.39	.28	
Healthy Palms									
Deglet Noor	.2014	.585	.502	.8680	.1923	.2160	.96	.23	
" "	.2006	.631	.485	.8780	.2090	.2080	.53	.16	
" "	.1673	.487	.435	.7272	.1573	.2235	.73	.27	
" "	.1570	.407	.394	.6794	.1449	.1681	.63	.22	
Decline-Diseased Palms									
Deglet Noor	.0956	.326	.030	.4116	.0995	.0719	.33	.14	.25
" "	.1244	.414	.414	.5326	.1175	.0439	.74	.17	.17
" "	.1408	.568	.426	.5912	.1521	.0482	.69	.26	.23

ences in the vegetative or reproductive portions of the palms of the various varieties were known, they might constitute a starting point in a study of the varying susceptibility of the varieties to different factors.

Samples of mature fruits of all available varieties in the Coachella Valley in California and a limited number of fresh fruit samples from Arizona were collected, prepared for analysis, and analyzed according to the procedure described by Haas and Bliss (3).

Table 1 gives the results obtained from fruits collected in Coachella Valley. All of the samples were picked on October 17, 1930, except those from diseased palms which were collected on September 28, 1932. The data suggest that the ash, calcium, potassium, and sodium of the dried fruit pulp of the Khadrawy and Halawy varieties exceed that of the fruit of the Zahidi, Kustawy, Barhee, and Deglet Noor varieties.

Differences between the inorganic constituents of the dry pulp of fruit of healthy and decline-diseased palms of the Deglet Noor variety appear to be shown in the magnesium content which is greater in the fruit of diseased palms and in the inorganic (ash) phosphate which is least in the fruit of decline-diseased palms. Haas and Klotz (4) have already referred to the fact that soil areas having decline-diseased palms fix phosphorus more readily than the soil of the better locations. They have also pointed out that the total phosphorus content of the pinnae of decline-diseased palms is less than that of pinnae of healthy palms. It is possible that this reduced phosphorus content may be the result of a badly injured root system which Bliss (1) has shown as a condition in decline-diseased palms and that a retarded absorption occurs rather than an actual deficiency of phosphorus in the soil solution. The fruit may reflect the condition of the palm and may not be directly affected by the causal agent. However, the fruit of diseased palms in any case may be considered diseased in the sense that they are not normal.

The copper content of decline-diseased fruit ranged from 2.9 to 6.1 parts per million. Haas and Bliss (3) in preliminary determinations have shown the copper content of healthy Deglet Noor fruits of various stages of development as ranging from approximately 3 to 10 parts per million depending somewhat on the age of the fruit. The data obtained by Cleveland and Fellers (2) on packaged samples purchased on the market of fruits of the Halawy and Sayer varieties grown in Iraq showed a copper content of approximately 120 parts per million, which suggests that possibly the fruits were copper treated in the packing process.

As the data indicate, the ash content (Table 1c) of an average date of a healthy Deglet Noor palm is generally greater than that of a date of a decline-diseased Deglet Noor palm especially when the disease of the palm is one of long standing.

In the ash (Table 1b), the fruits of the decline-diseased Deglet Noor palms contain a slightly greater percentage of calcium, magnesium, and potassium and a slightly smaller percentage of potassium and phosphorus. This condition is approximately the same as that found by Haas and Klotz (4) in pinnae of healthy and decline-diseased Deglet Noor palms.

The potassium content of date fruits of the Coachella Valley is exceedingly high and is considerably higher than the values reported by Cleveland and Fellers (2) for fruits grown in Iraq as has been pointed out by Haas and Bliss (3).

In Table 2 the data are given for the fresh and dry weights of the pulp of an average fruit, for the fresh weight of an average seed, and for the percentage of ash in the dry pulp of fruits of different palm varieties. The fresh weights are subject to the variations in the degree of ripeness and the time of picking and hence are not as accurate an index of size as the dry weight. These data are fundamental to a study of varietal characters and yet thus far with the exception of the studies by Nixon (5) who has investigated the effect of various sources of pollen on the fruit size, the size of the seed, and the time of fruit ripening, they have been given but little consideration.

It is of interest to note the low dry weight of the pulp of an average fruit of both the Halawy and Kustawy varieties. The data of the samples of Halawy from Arizona agree with those of fruits from the Coachella Valley. The dry weight of the pulp of an average fruit of the Menakher variety by far exceeds that of the pulp of all the other tested varieties. Seed of the fruit of the Fard variety had the smallest fresh weight. The weights of the seeds of the fruits of the Kustawy, Barhee, and Maktoom varieties also were small as compared with those of seeds of other varieties. Although the dry weight of the pulp of an average fruit of the Menakher variety far exceeded that of the pulp of the fruit of the other varieties, the seed had a smaller fresh weight than that of the fruit of several other varieties. The seed of the fruit of the Hayany, Deglet Beida, Tadala, Saidy, and Menakher varieties weighed more than those of the other varieties.

Fifty gram samples of dry pulp were used in the determinations of ash. The percentages of ash in the dry pulp (no seed or calyx) of the fruits are listed according to the variety and the amount of ash. For the samples examined, the percentages for the Halawy, Khadrawy, Iteema, Hayany, Thoory, Deglet Beida, Tadala, and Tafazween varieties are among the highest while those for Rhars, Menakher, Maktoom, and Khalasa varieties are among the smallest. Conversely the data may be taken as indicating that the pulp

of the fruit of these latter varieties is richer in organic matter.

In the last part of Table 2 the data have been extended to include results on fruit of the Deglet Noor variety from a wide range of location in the Coachella Valley. It is seen that the fresh weight of the seed of the fruit of the Deglet Noor variety compares favorably with the weights of the smallest seeds of the fruits of the other varieties. The percentage of ash in the dry pulp of fruit of the Deglet Noor variety is relatively small when compared with that of the fruits of the other varieties.

The relatively low percentage of ash in the dry pulp of fruit of the Deglet Noor variety indicates a relatively active synthesis of organic materials by the vegetative portions. It would be of interest to learn whether the pinnae of the Deglet Noor and other palm varieties dispose of their surplus production of sugars daily or whether there is a storage in the vegetative portions on which the fruits draw when they reach a certain stage. If the pinnae supply sugars to the fruits as rapidly as the pinnae manufacture the sugar, then the cultural care of the palms during the period of increasing sugar content of the fruits becomes of the greatest importance. It is significant that the fruits of the various palm varieties consist of approximately constant percentage mixtures of inorganic and organic constituents for a given variety, and that the seed weight is also roughly characteristic of the particular variety. The vegetative method of propagation would tend to maintain these varietal characteristics. Any understanding of differences of disease susceptibility of the various varieties of date palm must include a knowledge of differences in physical and chemical characteristics of the varieties.

TABLE 2

Fresh and dry weights of an average fruit (seed and calyx removed), fresh weight of an average seed, and the percentage of ash in the dry pulp of fruits of different varieties of date palm

Variety	Fruit Collected	Garden	Average weight of one fruit (without seed) Fresh (grams)	Dry (grams)	Average fresh weight of one seed (grams)	Ash in dry pulp (%)
Halawy	Sept. 20, 1932	T, C*	6.67	4.17	1.056	3.76
"	Sept. 30, 1930	U, C	7.59	4.45	1.181	2.95
"	Oct. 17, 1930	T, C	6.23	4.97	1.207	3.24
"	Sept. 19, 1930	A, A		4.44	.949	2.89
"	Sept. 13, 1930	B, A		4.06	.818	3.25
Khadrawy	Oct. 6, 1930	P, C	8.27	5.42	1.162	3.38
"	Oct. 17, 1930	T, C	7.68	5.62	1.045	3.03
"	Oct. 6, 1930	U, C	9.93	4.84	1.108	3.27
"	Sept. 19, 1930	A, A		6.37	.989	2.58
Iteema	Sept. 8, 1932	M, C	8.36	4.80	.925	2.69
"	Sept. 28, 1932	D, C	7.45	5.47	1.008	2.61
"	Sept. 8, 1932	P, C	9.50	5.64	1.470	2.91
"	Oct. 13, 1930	U, C	8.89	4.59	.947	3.09
"	Sept. 19, 1930	A, A		6.99	1.053	2.26
Hayany	Sept. 19, 1932	R, C	10.86	5.63	1.705	3.22
"	Oct. 6, 1930	U, C	13.16	7.28	1.708	2.98
"	Sept. 19, 1930	A, A		6.61	1.526	2.50
"	Sept. 19, 1930	B, A		6.73	1.400	2.71
Thoory	Sept. 28, 1932	D, C	8.98	7.46	1.086	2.48
"	Oct. 6, 1930	U, C	8.08	5.48	.966	3.25
"	Oct. 20, 1930	U, C				3.49
Deglet Beida	Sept. 28, 1932	T, C	6.49	5.61	1.543	3.23
Tadala	Sept. 19, 1930	A, A		6.46	1.645	3.06
Tafazwein	Sept. 20, 1932	T, C	8.97	5.57	1.207	2.94
Fard	Oct. 17, 1930	T, C	8.46	6.55	.732	2.88
Sayer	Oct. 17, 1930	T, C	8.71	6.94	1.125	2.86
Zahidi	Sept. 20, 1932	T, C	7.80	5.94	.880	2.67
"	Oct. 6, 1930	P, C	7.61	6.20	1.096	2.73
"	Oct. 6, 1930	U, C	9.05	6.11	.940	2.75
"	Oct. 17, 1930	T, C	7.07	5.85	.977	2.53
Saidy	Sept. 19, 1932	R, C	12.62	7.40	1.683	2.54
"	Oct. 6, 1930	U, C	9.92	6.98	1.311	2.50
Amhat	Sept. 19, 1930	A, A		5.25	1.038	2.58
Kustawy	Oct. 6, 1930	U, C*	7.51	4.54	.755	2.40
"	Oct. 17, 1930	T, C	3.86	3.30	.600	2.35
Barhee	Oct. 13, 1930	U, C	11.03	5.61	.788	2.50
"	Oct. 17, 1930	T, C	10.31	7.34	.944	2.28
Tazizaoot	Sept. 19, 1930	A, A		8.28	1.200	2.51
"	Sept. 19, 1930	B, A		7.88	1.087	2.42
Rhars	Sept. 19, 1930	A, A		7.01	1.244	2.33
Menakher	Sept. 27, 1932	M, C	15.15	10.15	1.436	2.28
Maktoom	Oct. 13, 1930	U, C	14.69	7.61	.865	2.27
Khalasa	Sept. 20, 1932	T, C				2.16
Deglet Noor	Sept. 28, 1932	H, C	11.88	7.47	.886	2 41
" "	Sept. 28, 1932	D, C	11.53	7.41	.947	2.49
" "	Sept. 28, 1932	F, C	11.01	6.98	.864	2.38
" "	Sept. 27, 1932	P, C	7.17	4.35	.745	2.48
" "	Sept. 27, 1932	M, C	7.15	5.22	.712	2.31
" "	Sept. 28, 1932	D, C	9.24	6.56	.880	2.24
" "	Sept. 28, 1932	D, C	8.44	6.01	.808	2.28
" "	Oct. 17, 1930	T, C				2.48
" "	Oct. 6, 1930	U, C	8.75	5.39	.835	2.49
" "	Oct. 17, 1930	T, C*	10.48	8.22	.819	2.44
" "	Sept. 28, 1932	T, C	8.20	5.99	.884	2.35
" "	Sept. 27, 1932	M, C	5.56	4.09	.642	2.34
" "	Nov. 6, 1930	H, C	11.63	8.08	.871	2.49
" "	Oct. 17, 1930	HU, C	10.64	7.55	.868	2.22
" "	Sept. 28, 1932	S, C	6.85	4.40	.892	2.18**
" "	Sept. 28, 1932	S, C	7.60	5.80	.744	2.15**
" "	Oct. 17, 1930	HU, C	10.27	7.31	.873	2.14**

C* - Coachella Valley A* - Arizona ** - Affected with decline-disease.

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Value of Standardization to the Date Industry

By Frank Kramer, Bureau of Fruit and Vegetable Standardization
State Department of Agriculture

IT IS ALWAYS gratifying to members of the staff of the State Department of Agriculture to meet with friends who are on the producing end of this great business, and I am especially glad to be here at Indio today, for it enables me to tell you of the benefits which California's standardization laws have brought to the date industry.

Later, I am planning to discuss future benefits which those, and new laws may bring. But let us first review briefly the history of fruit and vegetable standardization in California. This should furnish us with a background of information that should clarify the immediate situation affecting dates.

To do so, it is necessary to go back to 1915, soon after the beginning of the Great War. The American date industry was then in its infancy, and when most Americans thought of dates,—undoubtedly they had visions of a desert oasis in far-off Africa, some restless sand dunes, and a flock of camels. Dates came — and still come—from the Near East as well as from northern Africa, in great sticky masses. Not much attempt at standardization there. And what a shudder Mrs. Housewife experienced as she set her imagination to work on those dates!

True, the camels and palm trees were romance itself—from a distance. But what about packing? What about unknown, filthy hands that might have fingered those sticky fruits? Had they been washed after picking?

Well, you and I know the answer. Dates were not always chalked down in the blue book of table fruits. Definite prejudices grew up against them. Some housewives said they were wormy. Others considered them unclean. And there you were—perhaps all were right in some degree.

But out in California — out here under the blue skies of our beloved Southland—there was then beginning a movement which the housewives didn't know of, at least the majority of them. It was fruit and vegetable standardization, as applied by the State Department of Agriculture, and it should ultimately make purchasing a package of dates as easy—assole objective is to get one sum of convenient — as safe — as ordering a bar of soap. Today we are going to see what this program is, what it does, and what it means to the date industry.

We mentioned a certain year — it was 1915. That was the year when California placed the first standardization law upon its statute books.

Oh, it wasn't much of a law then. You wouldn't need to consult an oculist even after reading it by the light of a match. In fact, — this meager but important law covered only a little more than two pages. By 1917 it was found desirable to enlarge the entire act, and it has continued to grow in volume and importance from that time on. Later,—during our discussion, I am going to tell you about the latest legislative shoots that have been pushed forth.

Before that, however, we should consider the fundamentals of fruit standardization as applied to the date industry. Let us begin by saying that while it is primarily intended as an aid to the producer, the law also provides for the protection of consumers. Naturally, these two objectives are closely associated. Any regulation that protects the consumer also protects the producer. The latter may not always think so, but their interdependence is so obvious that little defense of standardization seems necessary on that score.

As a matter of fact, the growers of fruits and vegetables in California are rapidly getting away from the idea that it is one of their rights to sell anything they may raise — no matter how poor it may be—if some other person is able or willing to pay for it. They have seen, and self-interest has proved it to them, that the marketing of only desirable fruit is a policy that pays big dividends in the long run.

Why? Because of confidence. I don't have to assure you men, skilled in the business of farming, that the success of any business dealing with mass consumption—like the growing of dates, for example—depends upon repeat sales. No business of any size can exist without this turnover.

How long do you think the date business would last if it were run like a confidence game—where the money, and then work on another customer? It might work out this way,—to use an absurd example:

Suppose I approach Mr. Haas, who preceded me on the program,—and say, "I need five dollars to get back to Los Angeles. Someone has rifled my pockets. Lend the money to me, and I'll repay you at 8:30 o'clock on Monday morning."

Mr. Haas looks me over carefully and concludes that Frank Kramer may be worth a risk. He pulls the bill out of his wallet, hands it to me, and off I go to the city. Promptly at half-past eight on Monday I approach Mr. Haas with a $5 bill and a cigar, for interest.

He is very much impressed, probably a little surprised. "Well, there's one honest man," he says to himself.

That's all right, but another week passes by, and then I approach Mr. Haas again. "Haas," I say, "I've been hard-pressed recently. There are some payments due on that orange grove I purchased. Can you loan me $50.00 for thirty days?"

Remembering the prompt action under our first arrangement, Mr. Haas agrees immediately. So off I go with the $50.00. **But I don't come back!** Now, that's the confidence racket. Trouble is, it can only be worked once. Haas quickly loses confidence in Kramer after such an encounter.

And what has all this to do with dates? Nothing directly, — but let's make a comparison to the story. Suppose Mrs. Housewife in San Francisco purchases a box of attractive dates put out by a reliable firm. They are very delicious—the product of warm sunshine and rich soil in the Coachella Valley. Next week she buys a second package—a box that looks the same. But it isn't the same. This one was sold by an unreliable dealer. Perhaps they aren't even California dates. They are dry, disagreeable. Some may be wormy. She immediately concludes that dates are unreliable,—decides not to make any further purchases, and is out of the market for a long time. Old confidence game again. When it is played too often in the date business, everyone's trade is hurt just so a few dishonest persons may receive a trifling profit.

Frankly, it is to prevent just such a situation that the California Fruit and Vegetable Standardization Act is enforced. It is designed to keep customers coming back for more and more dates. It is devoted to maintaining confidence. In it the growers of California dates have an opportunity to build themselves a permanent and profitable market that cannot be taken away even if lower-priced goods may enter the market in larger competitive quantities. In turn, it may capture sales from these inferior goods.

In applying this law, the State Department of Agriculture is the representative both of the date producers and the date consumers. Its sole object is to prevent deception and fraud. All growers of fruits and vegetables are affected alike, regardless of where the product may be sold.

The act specifically states that dates must bear a designation on each container showing the country of origin. Some may think that this places an undue burden upon the grower or producer of such a commodity, but it assists nevertheless in the general marketing plan. We all know that large quantities of dates are imported each year into California from foreign markets. That is one reason why all containers of dates must be marked. Sometimes the containers of such dates definitely stated that it was from California, and in other cases the origin was inferred.

The inspectors throughout the State of California have experienced considerable trouble this year, as well as past years, with certain packers of Christmas packages of dried dates. Some of these unscrupulous packers will put on the top of these Christmas packages a fine mixture of dates, prunes, figs and glazed pineapple, whereas in the bottom of these packages we never find an equal amount of dates, as these unscrupulous packers will put inferior fruits in the bottom layers.

The old law did not have sufficient teeth to warrant prosecution, — and therefore there has been enacted a new law which will amply take care of this condition, and it reads as follows:

"It is unlawful to pack any dried fruits, or mixture of dried fruits, with nuts, glazed fruits or confections in a fancy pack if the exposed portion does not consist of the same kinds or mixtures of dried fruits, nuts, glazed fruits or confections as in the unexposed portion of the contents of the container, unless the container is conspicuously marked on the top thereof with a label accurately describing the kinds of such dried fruits, or nuts, contained in the unexposed portions."

In Section 798 of the Agricultural Code, certain amendments have been thought necessary this year, and these seem so important that if you will bear with me for a few moments, I would like to read the complete new law:

"Section 1. Section 798 of the Agricultural Code is hereby amended to read as follows:

"798. Dates and date by-products shall be free from mold, — decay, worms, insect injury, insect debris or frass, fermentation, — sourness and bird pecks causing injury to the flesh.

"Not more than five per cent, by count, or in the case of dates packed in blocks, by weight, of the dates in any one container or bulk lot may be below these requirements, but not to exceed one-half of this tolerance shall be allowed for any one cause, except that no part of this tolerance shall be allowed for the presence of live insects.

"All containers and sub-containers of dates or date by-products shall bear upon them in plain sight **and in plain letters on one** outside **end** thereof, **the name of the person who first packed or authorized the packing of the dates or date by-products, or the name under which such packer is engaged in business, together with a sufficiently explicit address to permit ready location of such packer,** the net weight, and in letters not less than one-half inch in height, the name of the State or the foreign country where the dates were produced, directly preceded by the words "grown in" in like size type. All dates displayed for sale in bulk shall bear upon them in plain sight on the outside thereof, or upon a placard so placed as to have reference to such dates, in letters not less than one-half of an inch in height, the name of the State or the foreign country where the dates were produced, directly preceded by the words "grown in" in like size type. All containers or sub-containers of, **or placards having reference to** dates which have been subjected to a hot water or steam process treatment must be plainly marked, **in the place and manner herein designated for other marketing requirements,** in letters not less than one-half of an inch in height with the words "hydrated dates," or "steamed dates" — **and it shall be unlawful to place the designation "fresh" on containers or sub containers of, or placards having reference to such hot water or steam processed dates.** In the case of any containers or sub-containers of contents of not more than three pounds net weight, **the markings required by this section shall be placed on the top or side of the containers and with the exception of the name and address and net weight, shall** be in letters of not less than one-eighth of an inch in height."

The principal additions relate to the identification of containers. Under the old law, dates in storage were immune from inspection. Under the new law dates can be inspected anywhere they may be found.

The State Department of Agriculture has been conducting an inspection station at Banning for the purpose of inspecting all trucks carrying fruits and vegetables. All trucks hauling dates from Coachella Valley had to stand inspection at that point. Many lots were rejected that were contaminated with insect larvae or frass, and in some cases,—live worms. Dates have been found in other counties that were infested with insects.

Upon tracing the movement of some of these illegal dates,—we were told that these wormy dates were transported in sacks, and these sacks were hidden in the center of trucks carrying manure. When these manure trucks passed through our station there was no indication that they had dates buried in the middle. This is one of the problems that the inspectors are confronted with. The bootlegger resorts to any and all means to evade inspection.

The percentage of illegal dates thrown on the market is comparatively small, but nevertheless, this small percentage of defective dates has a demoralizing effect on the date growers who ship dates that conform to the requirements of the law. These inferior dates, upon reaching the retail markets, are advertised and sold at a ridiculously low figure,—thereby demoralizing the market on standard dates.

Effective Fumigation of Dried Fruits

(With Particular Reference to Dates)

By Dwight F. Barnes, Fresno, of the Bureau of Entomology, U. S. D. A.

Mr. Barnes' paper was a summary of a pamphlet on Dried Fruit Fumigation issued by the Dried Fruit Insect Laboratory, 712 Elizabeth St., Fresno. This report is a discussion of the different materials used in fumigating dried fruit, including the amount and method of use, cost and all other items which should be at hand by anyone making use of these fumigants.

It was thought best by the Date Committee not to attempt to summarize or publish part of this most useful paper but to refer all interested to the above address where copies may be secured.

Rainfall As Related to Dates Grown In the Southwest

By Dewey C. Moore, Scientific Aide, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture

THIS report presents a brief study of the rainfall records for Indio, Mecca, Imperial, Yuma, Needles and Phoenix stations, with more details for Indio than for the others. A chart showing the comparative monthly and annual amounts of rainfall for these stations up to 1920 was prepared by Dr. S. C. Mason and published in the Third Annual Date Growers' Institute in 1926 based upon the rainfall averages. This chart has been revised using the 1930 averages, since monthly and annual amounts have practically all changed from the 1920 averages. The Weather Bureau instruments were moved from Calexico to Imperial in January, 1926, from which time data from the Imperial station is used instead of Calexico. These records are called the normals, both the monthly and annual averages except that of Imperial which has only eleven years record for the averages.

From a meteorological standpoint it requires twenty years to make a normal for any one station either in rainfall, temperature, or any phenomenon record. The duration of the meteorological records for these stations is as follows: Indio, 54 years; Mecca, 25 years; Imperial Valley, 11 years; Yuma, 49 years; Needles, 39 years; and Phoenix, 34 years.

It is a well known fact that the fall period from August to about December first is a period during which dates are very susceptible to rain damage, to be more specific the period from about September 10th to October 20th. If heavy rainfall occurs during this later period dates are often damaged to such a point that the fruit is past salvaging. In this chart are shown the relative monthly amounts of rainfall that occur for that period. The occurrence of rainfall is greater during August than the other months of the fall season, but the damage to dates is usually less than that caused by the smaller average amounts in September and October. Because of its immaturity there is less splitting of the fruit, although checking which is followed later by "blacknose" probably occurs throughout this month from high humidity as well as rainfall.

A table of the monthly averages of the 8 a. m. and 12 m. readings of the relative humidity shows that the August readings are higher than those of September or October. June and September have the lowest relative humidity for the year.

Mean Relative Humidity in Percentage at Indio, California
Monthly Averages

January	46.66	July	37.13
February	44.61	August	37.75
March	38.58	September	30.66
April	36.49	October	35.84
May	32.45	November	39.40
June	31.22	December	46.54

Annual Mean Relative Humidity in Percentage at Indio, California

1923	40.59	1929	34.93
1924	38.87	1930	36.86
1925	39.66	1931	41.44
1926	37.98	1932	39.62
1927	40.46	1933	32.86
1928	39.00	1934	39.71

Average for 12 years subsequent to 1923, 38.49%

The ultimate object of this study is an attempt to determine the frequency of rainfall during the date harvest season. Several charts have been prepared to show graphically the daily, monthly and annual amounts for the Indio station; also a table of the precipitation which gives the monthly, seasonal, and annual amounts of rain in inches and hundredths of an inch for the period from November, 1877, to March 31, 1935. The averages on this table indicate that the rainfall for that period is 2.96 inches.

From an analysis of precipitation from various stations in California, it is possible to deduce cycles or recurrences of from 2-3 years, from 5-6 years, and from 22-33 years, these being superimposed upon a larger secular cycle of from 45-55 years; the first being more indicated in the Northern part of the State and the second, in Southern California. A curve plotted from the records of stations covering 50 years or more will show that the rainfall values are on the upward trend. According to Dr. A. F. Gorton of La Jolla, the maximum peak should be reached at the time of the next sun spot maximum in 1938-1940. A peak of a more or less super cycle was reached in 1927 and again in 1931 with a depression of the last five-year cycle in 1934. The amount this year up to date is 2.08 inches, which indicates that the peak of this super cycle should be reached in 2 or 3 years.

These charts of the daily rainfall for the autumn season also show the maximum temperature curves and humidity graph. These charts cover detailed records from August, 1918, to December, 1934, a total of 17 years for the fall period of 131 days, from the first of August to the 9th of December. They show the day upon which rainfall occurs either in measurable amount or a trace, the latter being indicated by the letter "T" in the chart. The greatest amount of rainfall during this period for any one day is 3.61 inches which is the absolute daily maximum for our Indio records. This occurred during the morning of August 24, 1920, when two thunder storms came together from opposite sides of the Valley. The month of August since 1918 has brought rainfall each year except two, those being 1924 and 1932. Most rainfall during this month is of the thunderstorm type. A semi-permanent low barometric pressure area extends up from the South, takes form beginning about May 15th and remains until the latter part of October. Sometimes this is temporarily broken up by the storms that pass along the Northern storm track and occasionally the magnitude of this low pressure area is increased by tropical cyclonic disturbances in the months of September and October.

Rainfall was recorded during the month of September for every year except four, those being 1927, 1928, 1930 and 1934. The most outstanding storms for September are those of September 26, 1919, with 1.5 inches rainfall; September 30, 1921, with 1.24 inches rainfall; September 18, 1929, with .8 inch rainfall; and September 2, 1931, with .58 inch rainfall.

Rainfall was recorded for the month of October for every year except two, those being 1924 and 1934. The most outstanding storms for the month of October were those of October 4 and 5, 1925, with 1.52 and 1.22 inches rainfall, respectively, a total of 2.74 inches for the storm; October 26, 1927, with .55 inch; and October 9 and 10, 1932, with a total of 1.13 inches.

Rainfall was recorded for the month of November for every year except three, those being 1920, 1924, and 1929. The most outstanding rain storms for the month were those of November 22, 1919, with 1.02 inches; November 1, 1927, with .5 inch; and

November 7, 1931, with .67 inch.

In December of 1926 a very marked amount of rainfall, totaling 3.38 inches, occurred during the short period charted. This rainfall was, of course, rather late for much injury to dates. All storms that occur in the United States enter on the West and South, or take birth within the United States. A major part of these go out over the Northeast, over New England. Sixty per cent of the storms that affect the United States travel along the Canadian border and this track is joined with the Southwest storms.

The U. S. Weather Bureau meteorologists are making improvements each year upon their methods of collection and to calculate forecasts for various sections of the United States. The data and forecasts should be of great help to us in our date work in the future. As forecast methods are improved, more and better instruments are used, the services of the Weather Bureau should be very valuable to the date grower, giving storm warnings of rainstorms so that precautionary measures for protection of the fruit can be taken prior to the occurrence of rain.

U. S. WEATHER BUREAU RECORDS OF PRECIPITATION
Monthly, Seasonal, Annual and Average Amounts (in inches and hundredths)
Indio, California

Season	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Seasonal	Year	Annual
1877-78					.0	1.98	.10	.0	.0	.0	.0	.0		1878	1.10
1878-79	.0	.0	.0	.0	.0	1.00	.60	.30	.0	.0	.0	.0	1.90	1879	1.30
1879-80	.0	.0	.0	.0	.40	.0	.0	.0	.0	.0	.0	.0	.40	1880	.70
1880-81	.0	.0	.0	.0	.0	.70	3.45	.0	.50	.0	.0	.0	4.65	1881	3.95
1881-82	.0	.0	.0	.0	.0	.0	1.50	.0	.0	.0	.0	.0	1.50	1882	2.50
1882-83	.0	.0	.0	.0	1.00	.0	.80	1.13	.11	.0	.0	.0	3.04	1883	2.96
1883-84	.0	.0	.0	.06	.0	.86	.0	3.16	.62	.44	.46	.0	5.60	1884	5.38
1884-85	.0	.0	.0	.0	.0	.70	.0	.0	.0	.00	.0	.0	.80	1885	1.00
1885-86	.0	.0	.0	.0	.90	.0	.0	.0	.0	.0	.0	.0	.90	1886	.12
1886-87	.0	.0	.0	.0	.12	.0	.0	.93	.0	.30	.0	.0	1.35	1887	1.43
1887-88	.0	T	.05	.15	.0	.0	75	.0	.0	.0	.0	.0	.95	1888	2.96
1888-89	.0	.0	.0	.0	1.10	1.11	.57	.0	1.05	.0	.0	.0	3.83	1889	6.47
1889-90	.0	.95	.0	.60	.01	3.29	.65	.06	.0	.0	.0	.0	5.56	1890	1.23
1890-91	.0	.10	.20	.0	.0	.22	.0	1.90	.0	.0	.0	.0	2.42	1891	3.31
1891-92	.0	1.16	.0	.0	.0	.25	2.00	.43	.22	.04	.14	.0	4.24	1892	2.83
1892-93	.0	.0	.0	.0	.0	.0	.03	.0	1.60	.0	.0	.0	1.63	1893	2.64
1893-94	.05	.75	.07	.0	.14	T	.0	.0	.0	.0	.0	.0	1.01	1894	T
1894-95	T	.0	.0	.0	.0	.0	6.01	.0	.0	.0	.0	.0	6.01	1895	6.01
1895-96	.0	.0	.0	.0	.0	.0	.92	.0	.0	.0	.0	.0	.92	1896	.92
1896-97	.0	.0	.0	.0	.0	.0	1.10	.19	.0	.0	.0	.0	1.29	1897	3.39
1897-98	.0	.0	2.10	.0	.0	.0	.10	.0	.30	.0	.0	.0	2.50	1898	1.70
1898-99	.0	.30	.0	.0	.0	1.00	.40	.0	.0	.0	.0	.0	1.70	1899	1.30
1899-00	.0	.0	.10	.0	.60	.20	1.00	.0	.30	.10	T	.0	2.35	1900	2.74
1900-01	.0	.0	.08	1.04	.17	.0	.29	1.46	.0	.0	.0	.0	3.04	1901	1.75
1901-02	.0	.0	.0	.0	.0	.0	.40	.20	.0	.0	.0	.0	.60	1902	2.00
1902-03	.10	.0	.0	.0	.50	.80	.0	.0	.20	.75	.0	.0	2.35	1903	1.58
1903-04	.0	.10	.12	.0	.0	.41	.87	.35	.20	.0	T	.0	2.05	1904	2.43
1904-05	T	.33	.0	.08	.19	.41	.87	2.00	1.30	.0	T	.0	5.18	1905	5.37
1905-06	.0	.0	T	T	1.06	.14	T	.97	2.06	.47	.0	.0	4.70	1906	7.10
1906-07	T	1.07	.04	T	.66	1.89	.59	.63	.96	.0	.05	.0	5.83	1907	3.88
1907-08	.0	.0	.0	1.60	.05	T	.95	.57	.01	.0	.0	.0	3.18	1908	3.64
1908-09	T	.45	1.60	.0	.0	.60	.28	.29	.45	.0	.0	.0	3.13	1909	4.07
1909-10	.0	.87	1.12	.0	.20	.86	.47	.0	.08	.0	.0	.0	3.60	1910	1.05
1910-11	T	.08	.0	.12	.30	.0	.66	1.06	.22	T	.0	.0	2.44	1911	2.53
1911-12	.25	.0	.34	.0	.0	.0	.0	.0	1.66	.35	.53	.02	3.15	1912	4.50
1912-13	.04	.0	.0	1.90	.0	T	.12	.93	.02	.0	.0	.0	3.01	1913	1.95
1913-14	.26	.15	.40	.0	.07	.0	.82	.65	.06	.04	.0	.0	2.45	1914	2.74
1914-15	.36	.0	.0	.29	.35	.17	3.12	.57	.38	.19	.0	.0	5.43	1915	5.05
1915-16	.0	.35	.16	.0	.28	.0	3.53	.0	.02	.0	.0	.0	4.34	1916	5.12
1916-17	.30	.03	.72	T	.0	.52	1.65	.15	.0	.17	T	.0	3.54	1917	2.08
1917-18	.11	.0	T	.0	.0	.0	.03	.45	.71	.0	T	.21	1.51	1918	1.99
1918-19	.02	T	.04	.0	.25	.28	.10	.13	.27	T	T	.0	1.09	1919	3.11
1919-20	.39	.20	1.50	T	.52	T	.95	1.38	.37	.0	.32	.0	5.63	1920	6.80
1920-21	.0	3.61	.11	.06	.0	.0	.44	.0	.05	.0	.57	.0	4.84	1921	6.56
1921-22	T	.72	1.24	.06	.04	3.44	1.10	.21	.22	.0	T	T	7.03	1922	1.67
1922-23	.07	T	T	T	.03	.04	.03	T	.01	.0	.0	.0	.18	1923	.48
1923-24	.01	.21	.03	T	T	.19	.0	.0	.03	.27	T	.0	.74	1924	.70
1924-25	.0	.0	.05	.0	.0	.35	.0	T	.11	.03	.03	.32	.89	1925	3.52
1925-26	.07	.01	T	2.74	.04	.17	.19	.10	.02	2.17	.0	.02	5.53	1926	6.09
1926-27	T	.10	.10	T	.01	3.38	.07	3.15	.28	T	.0	.0	7.09	1927	7.87
1927-28	.57	T	.0	.70	.50	2.60	T	.59	.04	.0	T	.0	5.00	1928	.74
1928-29	T	T	.0	.05	.03	.03	.04	T	.08	.19	.0	.0	.42	1929	1.46
1929-30	T	.31	.84	T	.0	.0	2.02	.01	.66	.03	.33	.0	4.20	1930	3.28
1930-31	.04	.01	.0	T	.18	.0	.22	1.72	.02	.41	T	.07	2.67	1931	4.55
1931-32	.32	.24	.58	.09	.67	.53	T	1.53	.0	T	.06	.09	4.11	1932	3.49
1932-33	T	.0	.22	1.13	T	.46	.48	.0	.0	.14	.01	T	2.44	1933	.77
1933-34	T	T	T	.01	T	.13	.11	.09	T	.0	.0	T	.34	1934	.53
1934-35	T	.05	.0	.03	T	.25	.59	1.30	.19						
Average	**.05**	**.21**	**.21**	**.19**	**.18**	**.50**	**.71**	**.48**	**.27**	**.11**	**.04**	**.01**	**2.96**		**2.96**

Rainfall and temperature records have been kept at Indio since 1877. Up to June, 1903, these records were kept at the Southern Pacific station at Indio. On January 1st, 1906, the instruments and shelter were moved to the date garden of Fred N. Johnson, one and one-half miles west of Indio and about a quarter of a mile south of the Government Date Garden. Mr. Johnson was volunteer weather observer and took the records from January, 1906, to December, 1917. On January 1st, 1918, the instruments and shelter were moved to the Government Date Garden, where they have remained since. The records were reported by Mr. Bruce Drummond, former Superintendent of the Garden, from January, 1918, to March, 1923. Since this last date Dewey C. Moore has made the observations.

The Date Enterprise Efficiency Study

By H. B. Richardson, Assistant Farm Advisor of Riverside County

Mr. Richardson's paper was a preliminary report of the cost studies now being carried on by date growers in cooperation with the Agricultural Extension Service of the University of California. These studies are similar in plan to those which have been carried out on other fruits and are published annually. The first year had not been finished at the time the Institute was held but has since been completed and the First Annual Summary may be secured at the office of the County Agent, Riverside, California.

Soil Disinfection as a Means of Combating Decline Disease in Date Palms

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

ACCUMULATING evidence (2,3) points strongly to the conclusion that a soil fungus, tentatively identified as Omphalia sp., is the cause of decline disease. All of the underground portions of the date palm are attacked, although root decay is the most damaging effect. Fawcett and Klotz (6) mention a garden where in 1921, only a single palm was diseased, but by 1928, 31 trees were affected. More recent surveys showed this area to include 35 palms in 1932, 37 palms in 1933, and 59 palms in 1934. Similar instances of the enlargement of decline diseased areas have been revealed by surveys taken at yearly intervals in four other gardens. These areas do not seem to reach definite limits in size, as suggested by Fawcett and Klotz, but tend to enlarge in all directions at various rates up to 30 feet or more per year. In plantings of the Deglet Noor variety, every palm which stands at the margin of a decline area may be attacked as the disease advances. Palms of the Khastawy, Zahidi, Halawi, Tazizaoot, and Iteema varieties and certain seedling trees have remained in an apparently healthy condition although standing for a period of years adjacent to diseased palms on one or more sides.

It is not known whether Omphalia sp. is indigenous to Coachella Valley, or whether it was introduced. Bliss (2) has shown that the fungus may be carried to clean soil by means of offshoots which were taken from diseased palms. Four decline-diseased areas are known which apparently owe their origin to this source. Since the toadstool stage of the fungus has not been observed in the open, it is probable that spores do not play an important role in spreading the disease. Other means of spread such as the movement of infested soil and plant parts on farm machinery or in irrigation water are theoretically possible, but such spread has not been observed.

The problem of combating decline disease in Coachella Valley depends both on preventive and curative measures. An important means of prevention is that of using healthy offshoots for propagation. Where the disease is established, efforts to combat it fall into three catagories, namely: (1) curative treatments: (2) soil disinfection and replanting: and (3) the substitution of resistant varieties.

Bliss (3) demonstrated the presence of Omphalia sp. within the underground portions of decline-diseased palms. However, no data are available on the extent of its distribution in the plant. Before effective treatments can be made to eradicate the mold, it is important to ascertain the depth to which it penetrates below the surface of the soil.

In order to study the distribution of the fungus in a diseased area, a nine-year-old Deglet Noor palm was selected which showed severe stunting. A trench was dug, starting at the trunk and extending ten feet away from it. Cubes of soil, each containing one cubic foot, were excavated from one side of the trench. The roots from each cube were separated from the soil, and wrapped in waxed paper. After excavating a row of earthen cubes from the upper one-foot layer of soil, a similar row lying directly beneath was taken from the second-foot layer of soil. The procedure was continued until root samples had been obtained from 34 cubes of soil located from one to five feet below the surface, and laterally from one to ten feet from the base of the palm.

In the laboratory, tissue plantings from these root samples were made on corn meal agar. The fungus colonies which developed were examined microscopically to determine which roots contained Omphalia sp. While collecting the specimens, it was estimated that only one root in twenty was alive.

All of the dead roots contained fungi among which were Omphalia sp., Fusarium sp., Trichoderma lignorum (Tode) Harz, Alternaria sp., and Macrosporium sp. Omphalia sp. developed from root segments in the first,- second,- third,- and fourth-foot layers of soil, but in no case was it recovered from root segments at a distance of more than four feet from the trunk. The concentration of Omphalia sp. was greatest about the base of the trunk in the upper two feet of soil, while it was comparatively rare at a depth of four feet. No attempt was made to determine the presence of free-living mycelium or rhizomorphs of Omphalia sp. in the soil.

The first efforts to combat decline disease were made during the years 1929 to 1933. Seven fungicides and 19 different chemical fertilizers were applied in relatively large amounts on 321 palms in six widely separated gardens. The applications were repeated one or two times at yearly intervals. In 1931 Haas and Klotz (12) reported indications of growth stimulation and recovery in a diseased palm of Deglet Noor variety following the application of 50 pounds of

copper sulphate to the soil. However, this and many other chemical soil treatments were applied subsequently, but none gave uniformly beneficial effects in all gardens where applied.

Chemical soil treatments were applied to potted seedlings of Deglet Noor in the glasshouse. The first experiment is summarized in Table 1.

TABLE 1.

Effect of Inoculation with Omphalia sp. and of application of Copper Sulphate on Potted Seedlings of Deglet Noor Date Palm in the Glasshouse

Inoc. No.	Treatment of Soil, 6-2-32* Inoculated with Omphalia sp.	Copper sulphate applied**	Number of seedlings	Condition of Plant 7-18-33 Seedlings diseased	Chemical injury
117	yes	no (control)	9	55.6%	no
118	yes	yes	9	66.7	yes
119	no (control)	yes	8	0	yes
120	no (control)	no (control)	9	0	no

* Repeated 3-20-33. ** At rate of 50 pounds per circular tree basin, 20 feet in diameter, and applied in three equal doses at intervals of one week each.

Copper sulphate in solution was used at the rate of 50 pounds per circular tree basin, 20 feet in diameter, and it was applied to the soil in three equal doses at intervals of one week each. Omphalia sp. was grown on sterile bran and placed in the upper inch layer of soil at the rate of 80 cc. per square foot just preceding the chemical treatment. Uninoculated pots received similar amounts of sterile bran. The first soil treatments were made June 2, 1932; they were repeated on March 20, 1933; and on August 18, 1933, plants were harvested. It was found that the treatment with copper sulphate had not prevented the development of disease lesions, and that a certain amount of chemical injury was evident.

The second experiment with seedlings of Deglet Noor date palm grown in five-gallon can pots included five chemical soil treatments. Table 2 shows that 35.3 per cent of the date seedlings became diseased when grown in soil which was artificially inoculated with Omphalia sp. but untreated chemically. The percentage of diseased plants was only 22.2 in the Semesan treatment, but it was nearly doubled in treatments with copper sulphate, aluminum sulphate, and oxalic acid, and it was raised to 88.9 where heavy applications of potassium nitrate and triple super-phosphate were applied. Chemical injury was again associated with copper sulphate. Measurements of length of longest leaf, diameter of basal node, number of primary roots and of green leaves showed that the various treatments had not produced significant differences in plant size over a period of six months. There are two remarkable features about this experiment: (1) copper sulphate, which is highly toxic to many micro-organisms, was ineffective against Omphalia sp. when applied to the soil; and (2) a heavy application of chemicals containing available nitrogen, phosphorus, and potassium was attended by a percentage of diseased plants approximately two and one-half times that of the control.

Since in the above-mentioned instances these chemicals failed to kill or to prevent infection from the mycelium of Omphelia sp., it was believed that the same materials would have little effect on the fungus in naturally-infected palms where the fungus had already invaded the underground parts. For this reason, the effort to cure decline-diseased palms by chemical soil treatments was abandoned temporarily, and an attempt was made to devise more effective control measures.

Soil disinfection involves the destruction of living plants. When employed against Omphalia sp., the diseased palms are killed, and, after the disinfecting agent has disappeared, healthy offshoots are used as replacements. Since no previous work deals with soil disinfection as a means of combating decline disease, it is desirable to test the effectiveness of various chemical treatments used with success against other root-rot diseases.

Fawcett and Lee (7) describe the following method for treating soil which is infested with the oak root fungus, Armillaria mellea (Vahl.) Sacc.: Holes are bored 1½ to 2 feet apart in every direction and 18 inches deep. One and one-half ounces of carbon bisulphide is poured in each hole which is quickly plugged with soil.

According to King, Loomis, and Hope (13), individual sclerotia of the cotton root-rot fungus, Phymatotrichum omnivorum (Shear) Duggar, were killed by immersion in a one per cent formalin solution for about 30 minutes. King and Hope (14) describe an attempt to eradicate this fungus from an area near Indio, California, by the following method: A 1¼ per cent solution of formalin (commercial formaldehyde) was injected under pressure into the soil through pipes to a depth of six feet and at the rate of one gallon per cubic foot. Ezekiel and Taubenhaus (4) compared various chemicals including a number of chlorinated hydrocarbons and other volatile materials as to their relative toxicity to the cotton root-rot fungus and their ability to penetrate soil. When these materials were tested in the laboratory, pentachlorethane and tetrachlorethane were the most promising. In the field (5), both these

TABLE 2

Effect of Five Chemical Soil Treatments on the Pathogenicity of Omphalia sp. on Unwounded Seedlings of Deglet Noor Date Palm

Soil treatment: Chemicals used	Amount per 20-ft. tree square*	Seedlings inoculated with Omphalia sp. on 8-3-33: No.	Diseased**	Seedlings not inoculated (controls): No.	Diseased**
None (control)		17	35.3	36	0
Copper sulphate	50	9	66.7	9	0***
Aluminum sulphate	125	9	66.7	8	0
Potassium nitrate	100	18	88.9	18	0
Triple super-phosphate	100				
Semesan	1	9	22.2	8	0
Oxalic acid	46.3	9	66.7	9	0

*Applied in three equal doses at intervals of one week following 8-5-33. **Readings taken 2-15-34. ***Chemical injury noted.

chemicals and industrial xylol killed the fungus in roots when applied at the rate of 500 ppm. of soil weight to a depth of four feet. However, only scattered and stunted cotton plants were obtained from plantings made even three months after the tetrachlorethane treatment.

Oserkowsky (15) tested the fungicidal effect on Sclerotium rolfsii Sacc. of a number of compounds in aqueous solution and in the gaseous state. Sclerotia were killed after three days' exposure at 25° to 26° C. to the saturated vapors of 18 compounds among which was carbon bisulphide. Vapor of chloropicrin was reported to be non-lethal.

Godfrey (11) found chloropicrin to be an effective fumigant against the root-knot nematode, Heterodera marioni (Corner) Goodey, and (8) against seven species of soil fungi (including Sclerotium rolfsii and Armillaria mellea). Godfrey et al. (9, 10) stress the importance of confining fumigation gases within the soil following treatment.

An experiment was conducted in cooperation with Dr. H. S. Fawcett for the purpose of comparing four compounds as soil disinfectants against Omphalia sp. on roots of date palm and Armillaria mellea on orange roots. Large, healthy roots of date palm were cut in segments 10 cm. long, placed in flasks, and sterilized with steam. A culture of Omphalia sp. was then introduced and allowed to permeate the roots. The orange roots were obtained from naturally infected trees and cut in pieces 5 to 10 cm. in length. The root pieces were tagged individually for the purpose of identification and then buried at different levels in 20 large galvanized iron cans containing unsterilized soil. These cans were 13.5 inches in diameter by 23 inches deep and, when filled, they contained one date and one orange root at each of five levels which were 1, 6, 11, 16, and 21 inches, respectively, from the surface. At the time of treatment, composite samples of soil from five cans showed 4.99 per cent moisture in the top foot and 4.91 per cent in the second foot (dry weight basis). Air dry soil was found to possess 47.15 per cent air space, as determined by displacement by water, and one liter of air dry soil weighed 1324.5 grams.

Four cans were left untreated as controls. Carbon bisulphide, formaldehyde, tetrachlorethane, and chloropicrin were used in treating the soil in the other 16 cans, and each chemical was applied in two different amounts. A basic dose for each chemical was chosen at a strength which had been used effectively against some other soil fungus. The second amount was obtained by doubling the basic dose. The dosages were as follows:

	Basic dose*	Double dose*
Carbon bisulphide	0.5 liquid ounce	1.0 liquid ounce
Formaldehyde	2 gal. of 1 per cent formalin (1 gal. formalin plus 99 gal. water)	2 gal. of 2 per cent formalin (2 gal. formalin plus 98 gal. water)
Tetrachlorethane	0.242 liquid ounce	0.484 liquid ounce
Chloropicrin	0.169 liquid ounce	0.338 liquid ounce

*Amount applied per square foot of surface.

The chemicals were poured into holes, one in each can, which were made by driving a sharpened metal rod (½ inch diameter) in the soil to a depth of 18 inches. These holes were closed immediately after adding the disinfectant, and the soil was covered with two thicknesses of waxed paper and a half-inch layer of soil. Rain was excluded from the cans by a strip of roofing paper. No attempt was made to seal the cans against the escape of gases although the paper covers were pressed tightly against the surface. All cans had a one-inch hole for drainage in the bottom which was left uncovered.

The moldy root segments were taken up one month after treatment. From each root two tissue plantings were made on corn meal agar for the purpose of determining the presence of living mycelium. Omphalia sp. was recovered in all cases from date roots in untreated soil, but in no case from roots in soil treated with carbon bisulphide or with chloropicrin. The basic doses of formaldehyde and tetrachlorethane had little or no lethal effect on Omphalia sp. while the double doses of these compounds were partially effective. In general, it seemed more difficult to kill Omphalia sp. in the date roots than Armillaria mellea in orange roots.*

On the same day that the roots were taken up, each lot of soil was returned to the can in which it had been treated and it was planted with 200 seeds of Henderson's Early Snowball cauliflower. Judging from the condition of these seedlings two months after planting, chloropicrin had increased emergence and had stimulated growth markedly. The plants in carbon bisulphide-treated soil were slightly larger than those in untreated soil, but both the formaldehyde and the tetrachlorethane treatments were followed by stunted, unthrifty growth.

Based on this experiment, a study was made of the comparative cost of the four soil disinfectants. The amount of each sufficient to eradicate Omphalia sp. in the upper two-foot layer of soil in ten tree squares (9,000 sq. ft.) was calculated. Bids on these materials were obtained in the open market on February 13, 1935, from six leading chemical companies, and a summary of these is given in Table 3. It will be seen that for disinfecting soil against Omphalia sp. carbon bisulphide is by

*A more detailed account of this experiment is being prepared for publication in another place.

TABLE 3

The rate of application and the cost of four chemicals in amounts sufficient to eradicate Omphalia sp. in the first two feet of soil in ten tree squares (9,000 sq. ft.)

	Rate of application per square foot of surface	Amount needed in field (gals.)	Cost of material** Lowest bid	Highest bid
Carbon bisulphide	0.5 liquid ounce	37	$26.29	$30.04
Formaldehyde	*Two gallons of 4 per cent formalin (4 gal. formalin in 96 gal. water)	725	483.28	529.68
Tetrachlorethane	*0.97 liquid ounce (approximately)	70	101.26	120.26
Chloropicrin	0.169 liquid ounce	13	147.01	149.29

*Based on the assumption that an application is required which is four times as concentrated as the basic dose of the soil disinfection experiment herein reported.

**Obtained February 13, 1935, from bids on the open market in which six leading chemical companies were represented.

far the cheapest of the four materials used.

Soil disinfection using carbon bisulphide against decline disease has been used in Coachella Valley for more than a year. Forty-five tree squares in four gardens were treated in 1934, and similar work is now under way in other places. The procedure is briefly as follows: The diseased palm is taken up and destroyed. A rectangular area, 30 feet on a side and with the tree hole as its center, is cross-marked into squares which measure two feet on a side. Holes, 18 inches deep, are made at the corners of the small squares by use of a sharpened steel rod. An applicator, capable of delivering two ounces at a time, is used to pour the liquid carbon bisulphide. The holes are closed immediately after adding the chemical, and the soil is covered with layers of burlap, paper, or other material, and when possible, sprinkled with water to prevent rapid escape of the fumes. The dosage is increased to six ounces per hole in the location where the diseased palm stood. The soil cover is left in place two or three weeks or until the odor of carbon bisulphide has disappeared. After that time offshoots of date palm are planted.

Considerable labor is involved in soil disinfection in which the present home-made equipment is used. In 1934, two men required about 8 hours to disinfect 2½ tree squares. The minimum cost of removing the palm, levelling the soil, and of disinfecting one tree square with carbon bisulphide is $5.00 for labor and $3.00 for materials. The total cost involves in addition, the purchase and planting of a new palm and the expense of bringing it into production.

In the experiments in decline-diseased areas in 1934, healthy, rooted offshoots of the Deglet Noor and Khadrawi varieties were planted following soil disinfection. Certain tree squares which had not been disinfected (controls) were also planted to offshoots. This was done for the purpose of detecting any effect of soil disinfection on the palms and of determining the effectiveness of the treatment. So far as can be determined, carbon bisulphide produced no deleterious effect on the growth of the replants. As yet it is too early to judge how effectively the decline disease fungus was eradicated.

It is not known how long Omphalia sp. will live in soil in the absence of living date palms. The mold grows readily on synthetic culture media and on non-living organic matter. It has been re-isolated from dead, infected date roots one year after they were buried in unsterilized soil and from roots which were held in an air-dry condition for two years. A detached leaf base which was taken from soil in a decline-diseased area was virtually filled with the mycelium of Omphalia sp.

Trichoderma lignorum is one of the numerous soil fungi isolated from decayed portions of date palms. Weindling (16) has shown that this fungus will kill the mycelium of Omphalia sp. in a certain range of pH values. However, the writer failed to prevent infection of seedling date palms by Omphalia sp. by the application of Trichoderma cultures to infested potting soil in which the pH was not controlled. Although there seems to be no evidence that Trichoderma will control decline disease in the field, it may be instrumental in killing Omphalia sp. where suitable food or host plants are lacking.

Discussion

Soil disinfection is at present the most promising means of combating decline disease in areas where the infection threatens to spread to healthy, adjoining palms. Although rather expensive, carbon bisulphide acts quickly and then escapes from the soil as a gas leaving no harmful residue. The inflammable nature of this chemical is the most objectionable feature of the treatment. Also, there seems to be no satisfactory applicator which is available. It is hoped that with continued effort a practicable and effective method for combating Omphalia sp. may be devised. If this is not achieved, the future of the Deglet Noor and other susceptible varieties is threatened.

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Bunch Thinning Experiments with Deglet Noor Dates

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

EXPERIMENTS in the use of pollen to effect changes in the size and time of ripening of dates have emphasized the need for a study of the effects of thinning. Thinning, of course, is well-known to increase size and methods of thinning have been evolved that appear to be satisfactory for the Deglet Noor variety, as discussed by growers at previous date institutes, but there has been no background of experimental data to indicate the proportionate effects of different gradations of thinning and as to effects other than size, opinions have been diverse and observational evidence inconclusive.

In cooperation with Mr. Harry Whittlesey, Superintendent of the Krutz Ranch, experiments on a fairly large scale were conducted in 1934. Four rows of 11 palms each, planted in 1927 and about as uniform as can be found in a commercial planting, were used for the tests. Each row was given a different thinning treatment as follows: (1) no thinning; (2) commercial thinning as practiced in this date garden — cutting back tips of the strands enough to remove about one-third of the dates (or flowers at this period in their development) and in addition cutting out entirely a few of the strands in the center of the bunch, making a total reduction of about one-half, all done at time of pollination; (3) same as (2) except that the number of dates on the strands was reduced about two-thirds making the total reduction about three-fourths; (4) same as (3) except that the thinning was done on June 1st, at which time many growers regularly make a secondary thinning.

Because of the large number of flowers on a single cluster and the methods of thinning it is possible to make only a close approximation to any definite percentage of reduction. Furthermore at the time of pollination the set is not yet determined and there remains the early summer shedding and other factors which are responsible for a somewhat variable total reduction amounting commonly to as much as 50 per cent. The comparative size of the bunches in the different treatments just prior to the first picking in September is given in the accompanying table. This and other data secured at the same time was obtained from a field inspection of every bunch with a count and examination of individual dates on three typical strands. The yield data is based on records kept by Mr. Whittlesey who supervised the picking.

Except for the different gradations in thinning the palms were given the same treatment throughout. About June 1st the number of bunches on all palms in the garden was reduced and on palms of this age limited to an average of 8 to 12 according to the number of flowers produced and the relative vigor of the palm. Outside this range one palm carried 14 bunches and 4 had less than 8 while 2 produced no flowers at all. However, all the results are figured on the average per bunch so as to offset the variations in number of bunches carried by the different palms and different rows.

On July 23rd it was observed that the color change from green to the coral red of the khalal stage was slower on the unthinned bunches than on the others. This was followed by differences in time of ripening. The unthinned dates ripened approximately 1 to 7 weeks later than any of the other treatments, the difference increasing as the season progressed. The earliest ripening was in the row given heavy thinning June 1st. Between these limits were the two rows thinned at pollination, the moderate thinning being a little ahead in the early pickings but holding some of its fruit later than the heavy thinning.

One of the most striking results was the difference in the extent to which the different treatments were affected by blacknose. On July 23rd considerable checking was found on the thinned dates but almost none on the unthinned dates. This was followed later by comparable differences in the development of blacknose. In the check made just before the first picking in September it was difficult to find anything approaching blacknose on the unthinned row; there was relatively little on the moderately thinned row, but a considerable amount on both the heavily thinned rows, as is shown in the accompanying table.

It is possible that the absence of blacknose on the unthinned dates may be partly explained by their delayed maturity as the conditions responsible for the initial checking apparently occurred very early in the season when they would have been less susceptible. This, however, is not borne out by the variations in time of ripening as between the different thinning treatments for, as noted above, the moderate thinning at time of pollination was somewhat more advanced early in the season than the heavy thinning at time of pollination, yet regardless of time of thinning the proportion of blacknose was in direct ratio to the severity of thinning. It appears likely that thinning actually increases the susceptibility of Deglet Noor dates to checking and blacknose, possibly due to increased growth tension in the epidermal cells of the skin. This will have to be verified by further experiments, but meanwhile the writer has talked to a number of date growers who report having observed more blacknose as a consequence of heavy thinning.

As to size, the weight of the individual dates was increased in direct proportion to the severity of thinning. In the moderate thinning at pollination the increase in weight of fruit offset almost half the percentage reduction in number of dates. The heavily thinned bunches had 48.3 per cent less than the moderately thinned bunches, but the resulting yield was only 23.1 per cent less, whereas the individual dates were 26.3 per cent heavier. On the other hand, heavy thinning June 1st, comparable in amount to the heavy thinning at pollination, resulted in only a very slight increase in weight over the moderate thinning at pollination, indicating that the latter was approximately twice as effective.

The unthinned bunches were conspicuous early in the season for the large proportion of prematurely shrivelled dates, which were almost negligible on all the thinned bunches. In connection with this it is of interest to compare the ratio of abscission scars to number of dates per bunch. By abscission scars is meant the vacant places on the strands where flowers or dates had dropped off. Included with the abscission scars were the few calyxes or perianths left in some instances by the shedding of more mature fruit. The dates which dropped might have been pollinated or unpollinated and the

shedding might have occurred any time prior to the check made just before the first picking in September, but since the unpollinated dates remaining on the strands were not counted this ratio affords a valuable index to the total shedding and throws additional light on the physiological necessity for thinning. Contrary to what might be expected the relative amount of shedding was increased by thinning. The unthinned bunches, which obviously carried more fruit than they could mature properly, apparently lacked sufficient vitality to throw off enough dates by shedding to compensate. The almost identical proportions of shedding on the two gradations of thinning at time of pollination seem to indicate that when thinning is sufficient to enable the bunch to mature its crop further thinning has no effect on shedding. Yet the percentage of shedding was much higher in the June 1st thinning than any of the other treatments. Why this should be so is not altogether clear. Later thinning may be more of a shock to the bunch, but at least some of it is believed to be due to unavoidable bruising in thinning. It is almost impossible to handle a heavy bunch of dates without a slight breakage in many of the fibers connecting the date to the strand. This injury is frequently not apparent at the time but later often results in premature shrivelling or imperfect ripening.

The amount of shedding which occurred during the ripening season of 1934 was rather high for a year in which practically no rain damage occurred and has not been satisfactorily accounted for. An approximate index of this loss was obtained in these experiments by comparing the number of dates on the bunch prior to picking with the number per bunch calculated from the total yield and the average weight per date. A large proportion of these dates, especially from the larger bunches where the loss was greatest, are believed to have been knocked off the bunches in handling as much of the fruit when examined appeared perfectly normal.

As the fruit was sold at the ranch for delivery outside the Valley it was not possible to get packing house grades on any of the pickings. Random samples of 100 dates per palm were taken from each picking and graded into A, B, and C grades and culls. In establishing grades observations were first made on the initial grading as practiced in the local packing houses so that the standards set would conform fairly well to local usage. Grade A corresponds to "Fancy" and includes only fruit of good appearance and texture with no hard or dry portions. Grade C includes all the drier fruit; dates with pronounced blacknose were put in this grade. Grade C covers the two initial grades as now set by the largest of the local packing houses. Grade B covers all fruit between A and C except culls and corresponds to "Choice." The samples from each palm were graded separately and the results averaged for each row. From the percentage of each grade as determined from the mean of the samples the number of pounds of fruit of that grade in each picking was calculated.

In order to determine the effect of thinning on quality, size was not considered in grading, but the dates were weighed after grading. It was shown by measurements of samples of normal fruit just prior to the first picking that the unthinned dates averaged less than an inch and a half in length and while some of the later fruit was somewhat larger in no instance did the weight records throughout the season show a size as large as 45 to the pound, the present requirement for A grade fruit. Most of those graded as A would have been B commercially. The average of the unthinned dates graded as B was 56.14 to the pound, hence over half the fruit would have been disqualified because the dates were smaller than 55 to the pound, the limit for this grade. Thus because of their small size alone there were according to present standards no A grade dates in the unthinned treatment and only about half as many of B grade as shown in the tabulation. Since the weight standard for dry Deglet Noor dates is the same as for Choice, practically all the dates graded as C from the unthinned treatment would have been classed commercially as "Off-Grade" fruit. In sampling A and B fruit from time to time a tendency was noted for a little more immature flesh to be present around the seed of the unthinned

SUMMARY OF EXPERIMENTAL DATA

	No thinning	Moderate thinning at pollination	Heavy thinning June 1	Heavy thinning at pollination
*Average number dates per strand	41.9	27.1	14.1	15.5
Reduction of dates per strand—percent.		35.3	58.1	63.0
Average number strands per bunch	57.7	39.6	41.9	35.8
Reduction of strands per bunch—percent.		31.4	27.4	38.0
*Average number of dates per bunch	2417.63	1073.16	590.79	554.9
Reduction of dates per bunch—percent.		55.6	75.6	78.0
*Ratio of abscission scars to number of dates—percent.	21.3	44.5	61.7	44.6
*Premature shrivelling—percent.	15.6	1.3	.8	1.3
Estimate of loss after beginning of harvest—percent.	22.3	15.9	11.9	2.6
*Blacknose—percent.	.007	4.4	17.9	17.3
*Checking—percent.	2.8	32.2	36.4	38.9
*Average length of dates—inches	1.46	1.62	1.67	1.72
Average yield per bunch—lbs.	25.38	19.08	10.92	14.67
Reduction of yield per bunch—percent.		24.8	57.0	42.2
Increase in average weight per date—percent.		26.2	30.2	59.4
Grade yields (size not considered)				
A: Per cent	5.2	4.5	2.0	5.5
Average number lbs. per bunch	1.32	.86	.22	.74
Average number dates per lb.	50.7	42.2	42.4	35.8
B: Per cent	42.3	54.1	39.4	53.4
Average number lbs. per bunch	10.74	10.32	4.3	7.24
Average number dates per lb.	56.14	44.87	42.91	36.55
C: Per cent	45.8	38.9	55.3	39.3
Average number lbs. per bunch	11.62	7.42	6.04	5.31
Average number dates per lb.	62.82	47.9	47.0	37.13
Culls: Per cent	6.7	2.5	3.3	1.9
Average number lbs. per bunch	1.7	.48	.36	.26
Effect on ripening (estimated from graph)				
50% ripe by	Oct. 29	Oct. 4	Sept. 28	Oct. 9
75% ripe by	Nov. 29	Oct. 17	Oct. 6	Oct. 19
90% ripe by	Dec. 23	Oct. 31	Oct. 17	Oct. 29

*From field check prior to first picking in September

dates than in fruit of the same grade and appearance from the other treatments.

All the fruit in the thinning treatments met the minimum size requirements of the grade standards satisfactorily. Taking the experiment as a whole without regard to size of fruit none of the thinning treatments increased the total grade yield. The percentage of A grade is quite comparable except for the marked reduction in the June 1st thinning. It is probable that the percentage of A grade fruit would have been higher in the heavy thinning treatments had it not been for the high percentage of blacknose. The percentage of B fruit was increased more than 10 per cent by thinning at time of pollination, although the total yield was reduced by thinning as compared to the unthinned treatment. The two gradations of thinning at pollination are so nearly comparable in the percentage of the different grades that there is no apparent compensation for the further reduction of fruit in the case of the heavy thinning. The June 1st thinning made a very poor showing as regards grades, part of which may have been due to handling at time of thinning as previously suggested.

The 1934 crop does not tell the whole story. All the palms in the unthinned row flowered in 1934 producing 8 to 18 spathes and carrying 8 to 12 bunches, but on March 28 only 3 palms had spathes out with a total number of 20, whereas every palm in the other three rows had put out spathes with a normal crop already in sight in most cases, though the number on the moderately thinned row was less than on the other two. While the flowering season is not quite over the record thus far points clearly to a carry-over effect of the heavy crop last year and indicates that the crop borne by a palm must be limited to its capacity if consistent annual production is desired. Capacity, as every grower knows, depends upon the age and vigor of the palm and the cultural conditions under which it is grown—factors which will always be somewhat variable in different gardens.

These investigations are being continued with further tests under different conditions this year. Meanwhile the results of the 1934 experiments verify the experience of growers as to the necessity of thinning to increase size and to limit production to the capacity of the palm. Beyond that it was not evident that further reduction in the size of bunches was compensated by an increase in the percentage of higher grade fruit, and the heavier thinning resulted in a much larger proportion of blacknose. Thinning June 1st was only about half as effective in increasing size as thinning at pollination and resulted in lower percentage of higher grade fruit. Unthinned dates were much slower to ripen than thinned dates and the palms which bore the heaviest crop last year are showing a tendency to lay out this season.