

## OUTLINE OF CITRUS WORK

BEGUN IN NOVEMBER 1907 IN SALT RIVER VALLEY ARIZONA

BY J. ELIOT COIT.

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### OBJECTS:

It has been well known for some time that the Citrus and especially the orange groves in Salt River Valley are not in a healthy condition. The yields of fruit have been very small as compared with California yields. Growers have complained of various sickly and unhealthy conditions existing. There is no orange scale or white fly in the Valley, it having been pretty well demonstrated that scale, at least, will not thrive in the severe light and heat of the summers.

I decided to make a survey of all the orchards in the valley and study carefully and compare the different conditions and degrees of ill health in which I should find the trees.

This survey was made in early November, 1907 and every orchard in the valley over 2 acres in extent was studied, except one owned by a Mr. Trotter, which was overlooked.

### SURVEY

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The total number of acres was found to be approximately 641, twenty-four of which were planted in the spring of 1907. Most of the groves are of about the same age having been planted by the various improvement companies in 1893-4 and 5. Of this amount about  $15\frac{1}{2}$  acres were in lemons, 5 acres in pomelos, and 2 or 3 acres in tangerines. The great majority of the remainder is planted to Washington Navel oranges (Bahia), with a sprinkling of Valencia late, Parson Brown, Ruby Blood, Jaffa, and Australian Navels. The groves are situated mainly on the foot hills of the south slope of Camel's Back Mt. under

the Arizona Canal; also westward to and beyond the northern extension of center street. There are only four groves of size on the south side of the river, one southwest of Tempe, and three near Mesa.

Practically all the growers on the north side of the river have formed an association for the purpose of packing, shipping and marketing their oranges. The Central packing house is located in Phoenix. The freight rate on 80 lb. crates in car load lots to Chicago and New York is \$1.00 per crate. The 1907 crop is called a good one by the growers and the estimated out put of the groves north of the river is 110 cars.

#### OBSERVATIONS ON CULTURAL METHODS.

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##### CULTIVATION

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As was anticipated, the orange groves of Salt River Valley represent all degrees of cultivation, from those which are kept in the finest state of tilth to those neglected ones which are overgrown with weeds especially sunflowers taller than the trees themselves. The principal object in cultivation seems to be the destruction of weeds; whereas the main object should be, to maintain a fine dust mulch on the surface. With this object in view three benefits would result; 1st the irrigation water would be conserved for the tree roots and not lost thru surface evaporation; 2nd the soluble salts injurious to orange trees would be hindered to some extent from accumulating in undesirable quantities at the surface; 3rd, weeds would be prevented rather than destroyed.

##### IRRIGATION

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As a rule the groves on the South side had received sufficient water and were in a fairly healthy state. On the North side however and

especially under the Arizona Canal there had been a serious shortage of water, some of the groves going dry for as much as six weeks during Aug. and Sept. At times when small amounts of water were available, it was hurriedly run through shallow furrows on two sides of the trees wetting the soil for only a short distance down. This tends to encourage the formation of feeding roots near the surface where salts are concentrating, and in the event of a subsequent shortage of water the tender roots are left in a peculiarly helpless condition. In only two or three groves was the irrigation done by flooding and then only in a half-hearted way. In no case was the California method of individual flooding used. It appears to me that this latter method, while requiring more labor and skill would be vastly better for the trees, for in this case the water would be held stationary about each tree, and on all four sides until it could sink deeply into the soil over the entire feeding area of the tree roots. Great care should be taken to prevent the water from coming in contact with the trunks of the trees, as that is said by several authorities to be favorable to the Mal-di-goma.

#### FERTILIZATION

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At the present time very few growers use fertilizer. Mrs. W. A. Wilson informed me that in past years previous to the death of her husband, a commercial fertilizer recommended by this station was used in her grove with beneficial effect. At the Ingleside groves, stable manure was used in previous years, but as it seemed to increase mal-di-gome, and did not increase the crop in proportion to the cost of the manure, its use was discontinued. It may be noted here however that at the present time the fruit from these groves brings a higher price on Eastern markets than any other Salt River Valley oranges, and it is quite possible that this may be at least partly due to the after effects of this early manuring. Mr. Fred Foltz the pioneer orange grower of

Salt River Valley reported that he had tried nitrate of soda on alternate rows and was entirely unable to see any difference in yield between fertilized and unfertilized rows. Altogether, the question of fertilization does not seem to be a vital one at present though it may become so in the future. Several growers were of the impression that an application of sulfate of iron, or iron filings would be beneficial, though the source of this idea seemed to lie in vague hearsay.

#### COVER-CROPS

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The common practice seems to be to allow the weeds and grass to grow in the fall and through the winter, to be turned under in the spring with the plow. This furnishes an irregular and uneven cover through the winter, and keeps the soil filled with weed seed. This system is better than no cover crop at all, as the humus thus added to the soil is very beneficial. In two cases I found cow peas being used as cover crops; at Ingleside, and at Mr. Aker's on center street. In both cases the peas were sown too late to make a very satisfactory growth before frost. In both cases also the stand was poor. It is probable that sour clover may prove a good plant for a cover crop, and its use was advised on some soils which were evidently lacking in humus.

#### PRUNING

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On the whole, the Orange trees of Salt River Valley have not been pruned at all. They have been allowed to grow in any shape they would, and are now full of dead and diseased wood all through the centers. The trees are in such shape that they could not hold up heavy crops if they should set them. More attention to thoughtful and systematic pruning of Citrus trees is one of the pressing needs of the industry.

#### SHADING

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It is thought by some that the intense sunlight in summer is

responsible for a part at least of the ill health of the foliage. Several years ago, a Mr. Young is said to have built a brush shelter over a ten acre block of Navels now owned by Mr. Flemming on the farm adjoining that of Mr. E. J. Bennitt. It is said that the trees under the shelter grew well but failed to set fruit, and the shelter was removed. On the Ingleside grove, a cloth shelter was built over a tree, but was later taken down. In neither one of these Experiments were careful or comprehensive notes taken by Experiment Station men.

#### SPECIFIC TROUBLES OBSERVED

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Bunches of yellow leaves.

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In some of the groves there were observed branches with bunches of yellow leaves. This seemed to indicate an unhealthy condition of some kind. No clue to the cause of this trouble has as yet been found, though the growers ascribe the trouble to a number of different causes.

#### MAL-DI-GOMA

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While a careful inspection for mal-di-goma was not made, two cases were brought to my attention. One was in the Ingleside grove, on sweet seedling orange, - a very pronounced case, and the other on Mr. Ritchie's (Christy's has been scratched) place occurring on several trees of Washington Navel.

#### GOPHERS AND FLECKERS

In many places in the Valley, gophers do great damage to the orange trees, by gnawing away the bark about the base, and on the larger roots, thus girdling and in some cases killing the trees.

One grower complained bitterly that woodpeckers had been pecking the oranges and inducing rot. He stated that several crates out of each days picking were found to be pecked and rendered unsalable. He had been

depending his Sundays shooting the birds. This was Mr. Fred Foltz and his grove adjoined the cactus studded mesa at the base of Camel's back Mt.

#### DIE BACK.

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Only one pronounced case of die back was found. This case occurred on the single orange tree (variety not known) growing in sod on the Experiment Station Farm, near the office floor. On this tree many of the young growths, a foot or more in length died back during November and December, and the cracking of the bark and large exuding drops of gum characteristic of this disease (as pictured in Florida bulletins) were very apparent.

#### THRIFT, OR SPOTTING OF THE SKIN

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This trouble proved to be very serious over the whole orange growing area, and especially on the South side where the fruit was of very fair quality otherwise. It is characterized by spots on the skin about 1/8 inch in diameter. These spots turn yellow while the orange is still green, and later turn brown as the fruit colors up. As it is only on the surface of the skin, the eating quality of the fruit is not affected, but it seriously injures its looks and salability. I have not yet found the cause of this trouble, but strongly suspect that it is due to an insect of some kind, probably one of two found on the trees, either Stictocipliala festina, the green alfalfa hopper, or the Mexican Chincha, Leptoglossus Zonatus.

#### FRUIT SCAR

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There is also a very serious trouble known as fruit scar of the orange. It affects only the skin and is very disfiguring to the fruit. Badly scarred specimens are often one sided or unsymmetrical in growth. These scarred oranges go as culls, and as in some groves the number of scarred oranges goes as high as 25 to 40%, the

seriousness of this trouble is readily seen. Affected fruit was found on all parts of the trees, both outside and inside. It may be caused by cold or frosty nights during blossoming time. However this question needs investigation. Some growers claim that this is caused by the young fruit brushing against the leaves while wet with rain.

#### CRACKING OF THE FRUIT.

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Especially in the groves under the Arizona and near the Cross-cut canal, was noticed the cracking and splitting of the fruit. Something like from three to five per cent was the extent of this injury in the groves most seriously affected. It appears to me that the cause of this trouble lies in the shortage of water during the growing season. If the growth comes at a time when the young fruit is rapidly expanding, it is checked in its growth and the skin becomes set, as it were. Later, when an abundance of water comes into the canal, the growers try to make up for past shortage by heavy irrigation. This causes the fruit to expand rapidly again, splitting the oranges and exposing them to gnats and worms which soon cause decay.

#### BLACK ROT OF NAVELS.

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Black rot of the navel orange was found in fairly uniform amounts in all groves visited. The injury seemed to run from 1 to 3%. Diseased specimens were collected by the writer and forwarded to Dr. McCallum who cultured the fungus. Later the writer discovered that Prof. N. B. Pierce of the U. S. D. A. Pacific Coast Laboratory, Santa Ana, California had studied and described the fungus as a new species. Alternaria Citri in Botanical Gazette 33 (1902) P. 234. This fungus has been observed in Arizona before and noted by T. D. A. Cockerell

in Arizona Bull. No. 32 P. 289. According to Prof. Pierce, the fungus enters the orange thru imperfections of the peel about the navel, which is an abnormal structure and not in all cases fully protected. If this is the case, the only remedy would seem to be prevention, by carefully gathering and burning all diseased fruits and thus reducing the quantity of spores available for infection.

#### THE NEW ORANGE WORM

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While I was careful to look for specimens of the new orange-worm described by Cockerell in Arizona Bull, No. 32 P. 289, I did not succeed in finding any. Several growers however informed me that they had noticed a few specimens each year which contained worms, and their verbal description corresponded with that found at the above cited reference.

#### THE ANGULAR-WINGED KATYDID

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#### MICROCENTRUM RETINERVIS

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In a few groves the work of the angular-winged Katydid was seen, notably that of Mr. Reed, near Mesa. The total injury done by eating the leaves was insignificant. See Arizona Bull, 32, P. 281 and for full description with illustrations see Rept. of U. S. D. A. Secretary 1880 p. 249 and 368.

#### LEATHER-LEAF.

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This is an empirical name, which I, in want of a better one, have given to a very serious physiological disease of orange foliage. So far I have been unable to find a description in the Citrus literature at my command, to conform to it. and therefore conclude (tentatively and pending a trip to California groves) that this trouble is peculiar to Arizona conditions. The disease is characterized by a thickening of the leaves, at the same time the area of leaf

surface is much reduced and twisted, onesided and various abnormal and unsymmetrical forms appear. The leaves are affected in this way as they unfold, and may be found on both spring, summer and fall growths, and as well on vigorous water sprouts as on weaker branches, and as well in the shaded center of the tree as on the outstanding and exposed branches. The trouble is usually most severe on the upper branches, but often includes practically all the leaves on the tree, producing a stunting of growth and a decrease in size of fruit. The diseased foliage neither turns yellow nor drops off, but remains green with a few faint white or light green blotches over the thick places in the tissue, and usually extending lengthwise of the leaf between mid-rib and margin. Often in severe cases the leaves are reduced in size to mere rudiments along the shoot. The Washington Navel is the variety principally affected. On the farm of Wm. Ellsworth near Mesa, the navels were slightly affected while the Parson Brown was not affected in the slightest. Only in very rare cases was grapefruit affected and then only on a few leaves. Lemon is only very slightly affected. This disease was the most severe in those locations where the water supply had been short during the summer, and where the alkali was the strongest. Taking all my observations together it seems to me very likely that this disease is caused by an unhealthy condition of the roots, which in turn is caused by shallow and infrequent irrigation drawing the roots up to the surface layers and leaving them in that part of the soil in which the soluble salts are strongest. This theory is strengthened by the fact that in no orchard were all the trees affected in the same degree, but among the sickly trees could be found a few trees apparently quite healthy and vigorous with almost perfect foliage. This seems to coincide with the uneven and patchy nature of alkali lands. Abundant material has been collected and fixed in alcohol for laboratory work in studying the structure and

cytological condition of the diseased leaf and stem tissue. One of the most interesting groves visited was that of Mr. Halm on the North side Cross-Cut canal. The overseer is Mr. Robinson. On this ranch there are two groves, one of 10 acres on the North west corner and another of 20 acres on the South east corner with the house and garden between. Both are watered from the Cross-Cut Canal but the 10 acre grove is slightly more elevated. The soil in both cases is a fine reddish gravel, said to be just the soil for oranges. Both groves are Washington Navels. In the 20 acre grove the usual amount of Leather-leaf was apparent, with many individual trees in very bad condition. I inspected the 10 acre grove very carefully and was about to conclude that I could not find a single diseased leaf in it, but found a dozen or so trees in the extreme North East Corner slightly affected. The culture seemed somewhat better in the 10 acre grove than in the other. Whence this great difference in the condition of these two groves? This is a very interesting question. If the presence of alkali is responsible for the Leather-Leaf disease, it would seem that a careful comparative study of the soils of these two groves would furnish very interesting and valuable data. I contemplate making such a study in the near future. A sample of soil taken by Prof. Forbes, from a site where orange trees were suffering, showed 19800 lbs. of salts per acre in uncultivated tree rows, 16600 lbs. per acre in temporary ridges, and 5300 lbs. in furrows flooded every 8 days. This in the upper three feet of soil. In California (Rpt. 1897-8 p. 101), 10920 lbs. of salts per acre in upper four feet of soil caused the orange trees to drop all their leaves and come very near dying. In fact they would have died had they not been flooded with pure artesian water.

## STOCKS

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In my entire survey I was unable to find any trees grown on trifoliata stocks, tho they reported by Hume and also the California Station to be resistant to alkali, and also cause the trees to withstand more cold. It is my purpose to experiment on the trifoliata stock for Salt River Valley and especially the Satsuma orange grafted on trifoliata stocks for the environs and gardens of the City of Phoenix. It has lately been discovered that there is one small tree of Satsuma on trifoliata stock now growing near the green houses of the Experiment Station at Tucson. This tree should be favored as much as possible by removing the walnut trees now crowding it, and by giving it plenty of water.

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Jean Sowell typed this from the original manuscript in 1958.

Loretta Hawker retyped it May 26, 1965.