Lemon Response to Phosphate

vegetative growth stimulated by soil application of phosphate to trees showing leaf symptoms of deficiency

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Part I of a two-part progress report on response of lemon trees to phosphate fertilization.

Lemon trees have responded to soil applications of phosphate fertilizers in current field experiments.

To determine the effect of soil applications of phosphorus and potassium fertilizers on lemon trees showing leaf symptoms associated with a low content of phosphorus and potassium field trials were conducted in four locations.

The first trial was established in April, 1949, in a grove of Eureka lemons on Rough lemon rootstock in a Yolo gravelly, fine sandy loam, near Fillmore, Ventura County.

The other trials were established in San Diego County in November, 1949—one near Escondido, in Eureka lemons on Sweet orange rootstock in a Fallbrook sandy loam; the second, in Lisbon on grapefruit rootstock near Rancho Santa Fe on Olivenhain loamy fine sand; and the third, near Vista in Eureka on grapefruit rootstock in Las Flores loamy fine sand.

The soils of all the test plots are moderately acid in reaction to a depth of two feet.

Four fertilizer treatments involving five single tree replications were applied broadcast in one application at each location.

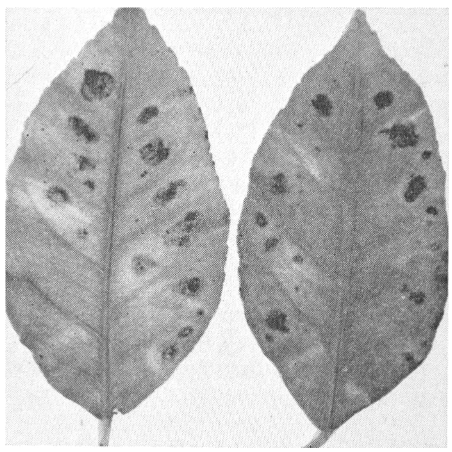
The treatments were:

1. Nitrogen at the rate of seven pounds of ammonium nitrate per tree—2.3 pounds of nitrogen per tree.

2. Nitrogen plus phosphorus at the rate of 20 pounds of 11–48 per tree—2.2 pounds of nitrogen and 9.6 pounds of phosphate per tree.

3. Nitrogen plus potassium at the rate of seven pounds of ammonium nitrate per tree and 20 pounds of potassium sulphate per tree—2.3 pounds of nitrogen plus 10 pounds of potash per tree.

4. Nitrogen plus phosphorus plus potassium at the rate of 20 pounds of 11–48 per tree plus 20 pounds of potassium sulphate per tree—2.3 pounds of nitrogen plus 9.6 pounds of phosphate plus 10 pounds of potash per tree.



Lemon leaves showing leaf spot symptoms associated with phosphate deficiency.

Within four months after the fertilizer treatments were applied at the various test locations—regardless of time of application, in the spring or fall—marked improvement could be seen in the vegetative characteristics of lemon trees receiving phosphate fertilizer. Little if any improvement could be found in the trees fertilized with nitrogen or nitrogen plus potassium.

A possible explanation of the relationship of vegetative response to fertilization may be found in the leaf analysis data obtained on leaves which were collected during May from the most recently matured cycle of growth found on the variously fertilized trees. This age of leaf seldom, if ever, shows the leaf spotting associated with a low phosphorus and potassium content.

Phosphate fertilization has—with the exception of the grove at Escondido—consistently increased the phosphate content of the lemon leaves from a deficient level—less than .08% phosphorus—to a sufficient level—greater than .10% phosphorus. The potassium content of the leaves collected from the various groves appears on the other hand to be adequate without potassium fertilization—above .35% potassium. The grove at Escondido is again an exception to this relationship. However, analyses of leaf samples collected from the grove at Escondido at bimonthly intervals since May 1950 show that phosphate fertilization has raised the phosphorus level of the leaves above 0.1% and that the potassium content of the leaves, regardless of fertilizer treatment, is above 0.4%.

The adequacy of potassium in recently matured leaves and the inadequacy of potassium in leaves showing leaf spots taken from the same trees probably can be attributed to the age difference that exists between the two series of leaves. Leaf spots are always on the oldest leaves on the tree.

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Chemical Composition of Lemon Leaves Collected from the Nitrogen, Phosphorus, and Potassium Fertilizer Plots
(per cent dry matter)

Grove	Treatment	Ca	Mg	K	Na	P	S	Cl
Fillmore	N	3.87	.23	.60	.07	.08	.28	.06
	NK	3.61	.19	.89	.07	.08	.30	.06
	NP	4.81	.25	.47	.07	.11	.29	.09
	NPK	4.18	.19	.76	.07	.10	.28	.06
Rancho Santa Fe	N	4.14	.30	.78	.08	.06	.40	.11
	NK	4.86	.35	.50	.06	.06	.36	.11
	NP	4.02	.27	.59	.07	.10	.37	.09
	NPK	4.14	.41	.61	.07	.09	.38	.09
Vista	N	3.74	.29	.57	.07	.06	.33	.14
	NK	4.69	.48	.31	.09	.07	.60	.17
	NP	4.42	.41	.54	.08	.16	.38	.14
	NPK	3.73	.27	.57	.08	.11	.33	.11
Escondido	N	4.74	.34	.20	.07	.06	.30	.12
	NK	5.84	.44	.23	.09	.06	.36	.17
	NP	5.18	.39	.24	.09	.09	.34	.11
	NPK	5.64	.39	.25	.07	.08	.34	.11

LEMONS

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Potassium and phosphorus content of leaves decline with leaf age so lemon leaves showing spots are consistenlty low in phosphorus and potassium.

Since lemon trees showing leaf spots respond to phosphate fertilization and not to potassium fertilization, it appears that the composition of recently matured lemon leaves is a better indication of the nutrient status of the lemon tree than is the composition of the older leaves which show spots.

The symptoms found on the older leaves provide a field method for recognizing a nutrient deficiency in lemons which appears to be associated primarily with phosphorus.

Lemon leaves showing typical leaf spot symptoms are illustrated on page 5. The spots are brown to black in color—depending upon how recently they were formed—and generally are circular in shape but occasionally coalesce to form an elongated ovalar spot.

The spots occur on the upper side of the leaf usually between the main lateral veins. They are distributed somewhat along and inside the leaf margin and produce a slight depression in the leaf surface. The depression may be surrounded or partially infiltrated with a resinouslike material. Where the burn is severe on the oldest leaves the center may drop out but generally the burn is confined to the upper surface of the leaf. The lower side of the leaf shows some discoloration of the leaf surface directly below the depressed area of the spot.

In the initial stages of the burn the leaf area immediately surrounding the burn is chlorotic and forms a halo. As the leaf ages the chlorotic area surrounding the burn expands between the main lateral veins so that the oldest leaves appear also to have the chlorotic symptoms associated with iron and manganese deficiency.

Since the burn occurs on older leaves it is most prominent in affected lemon trees in the fall of the year, becoming most pronounced in October and November. By spring most of the burned leaves have fallen, new growth has started, and the leaf symptoms are hard to find.

More than normal defoliation during the winter is characteristic of phosphate deficient lemon trees. The defoliation may start in early fall and accounts for the broomlike habit of growth seen in many lemon groves now known to be deficient in phosphate. Only the most recent growth flush of leaves remains on the branches. Leaves which show no spots are usually lusterless, and gray-green to bronze in color.

The phosphate deficiency symptoms described here for lemons have never been found on orange trees despite the fact that orange groves are planted on some of the same properties where lemons show phosphate deficiency and are under the same management program.

Phosphate fertilizer trials on Valencia oranges were established simultaneously with lemon trials in one grove in San Diego County in spite of the lack of deficiency symptoms on the oranges. Field observations and leaf analysis data on this orange plot reveal that phosphate fertilization has had no apparent effect on growth or on leaf composition. Lemon trees on the same property have responded.

When it became apparent—during these trials—that soil applications of phosphate were producing pronounced vegetative stimulation, it became obvious that yield data should be obtained.

Recently several new and enlarged phosphate trials have been established in San Diego County on phosphate-deficient lemon groves for the express purpose of determining—over a long period of time—the influence of phosphate fertilization on lemon yields in such groves.

Fruit quality studies also have been started.

Part II of the above article, Substantial increase in yield of lemons followed application of phosphate in trials in two counties, *will be published in the March 1951 issue of California Agriculture.*

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DECIDUOUS

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Although there is also a difference between varieties, plums and prunes usually suffer less from bud-drop than peaches. Apples and pears do not shed their flower buds, but the embryonic floral parts may dry up and become nonfunctional. Because of their high chilling requirement, a very prolonged period of bloom is the most serious effect of mild winters on flower buds of apples and pears.

Prolonged blooming periods enhance the problems of using the pest control measures usually applied during bloom, as for example, the problem of blossom control of fire blight in pears is made extremely difficult. Furthermore, prolonged bloom may upset provisions for cross-pollination in those species for which it is required. Scattered bloom and marked variations in the time of bloom of pollinating varieties may result in very light sets of fruit.

Problems of frost protection in the early blooming species, such as almonds, will be increased when the bloom period is protracted.

Another indication of the gravity of the current situation is the fact that there has been some at least mild bud-drop on some almond varieties. Because of their low chilling requirement bud-drop is practically unheard of in almonds. There probably will not be a serious loss this season in almonds from the bud-drop itself, since good chilling weather in late December probably checked this tendency on most varieties. However, there is a considerable variation between buds in their stage of development so that a long blooming period may pertain, a situation which might be unfavorable to set from the standpoint of cross-pollination and from an increased frost haazrd.

Bud-drop will probably be moderate to heavy in apricots, and a very light crop may result. Normally, unless at least 400 hours of chilling are received by January first, apricot bud-drop is heavy. In the second week of January no appreciable bud-drop had started on apricots, but microscopic examination of the buds revealed some signs of abnormality which indicate that a high proportion of the buds may shed.

The degree of loss to expect in peaches will depend largely on the chilling received in January and February. Microscopic examination of peach buds from some orchards around Davis indicate that a very heavy drop may occur, at least from trees relatively low in vigor and of those varieties most prone to shed their buds. It seems safe to predict that at least the peach crop will be considerably lighter than normal and that in most sections there will be a less than normal need for fruit thinning during the summer.

The probable situation with other fruits is not yet clear. Some bud-drop is likely on the most susceptible varieties of prunes and plums. However, those varieties producing a heavy set of buds should suffer proportionately less from loss of buds, although prolonged bloom and possibly poor pollinating conditions may reduce the crop. Cherries also will probably suffer from a period of extended bloom with a resultant relatively poor set of fruit. The pear picture will be determined largely by the adequacy of January and February chilling, though some reduction in crop may be expected.

The amount of chilling in January and February in northern California will probably determine the canned fruit picture because of the dominant part this area plays in the canned fruit supply. If the weather in these months is nearly normal, the reduction in the crop of peaches and pears may not be too great. If temperatures much milder than normal pre-

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