

## Boron Deficiency in Affected Areas of the State Readily Supplied by Simple Treatment

H. Earl Thomas and C. Emlen Scott

It may seem odd at first blush that California, which produces borax in large quantities, should have at least several thousand acres in which boron, the essential element for plant growth contained in borax and boric acid, is in short supply.

There are certain areas in the state where boron in the soils and waters is present in sufficient quantity to cause considerable injury. This is rather to be expected since the amount needed for a particular crop and soil may be as low as 10 or 20 pounds per acre. On the other hand, the lower limit at which borax may be toxic can be as little as a half pound to an orange tree or a grape vine. Fortunately, the narrow margin between necessity and safety has not thus far been a serious problem in this state.

### Pear and Olive Areas Most Affected

Boron deficiency has been seen and studied in many agricultural crops, many soil types and in many lands. The deficiency in California is more likely to be encountered in the upland areas than in the valleys. It is associated with nonirrigated areas or those watered with relatively pure water. It may be aggravated by poor drainage, heavy nitrogen fertilizer and particularly by heavy liming.

the tree develop characteristic pits which are more numerous at the blossom end. At times some caution is needed in distinguishing these pits from those caused by insect stings.

The olive tree takes on a bunched appearance at the ends of surviving branches. The tips of olive leaves turn first light green, later bright yellow or orange.

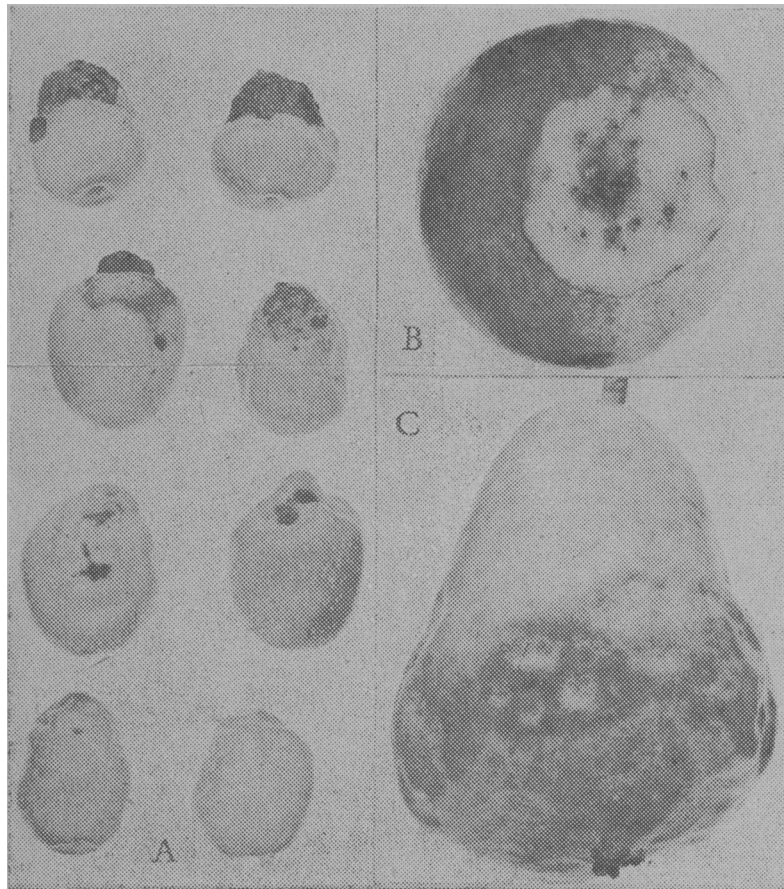
Severely affected pear fruits may crack but the most distinctive symptom is the pit. If a cut is made just beneath the skin at the base of the pit, there is seen a dark-brown core in the center surrounded by a light yellow circular area.

### Preliminary Test is Simple

Diagnosis should not be considered final until a few trees or branches have been cured. A simple way to make preliminary tests is to bore holes into branches two feet or more above their bases and introduce about half a teaspoonful of borax or boric acid into each hole. The holes are then plugged with wooden plugs or other stoppers. If an improvement is seen, the next problem is to decide what method to use for the rest of the orchard.

### Two Types of Treatment

For larger scale treatment, borax at one-half to two pounds per tree



A, Degrees of severity of boron deficiency symptoms in olive fruits. B and C, Sub-surface surface of views of pits in Bartlett pear fruits caused by lack of sufficient boron.

Several garden plants such as broccoli, cabbage, cauliflower, celery, radish, lettuce and beets and rutabaga are known to be affected in small areas in this state. But the principal affected areas in California seem to be planted to tree fruits, notably olive and pear.

Tests conducted in 1941 and 1942 in Butte County demonstrated that several hundred acres of olives in that County might profit by addition of one or two pound applications of borax per tree. Increases in yield of several fold were obtained in some cases. A similar olive growing area came to notice later in Shasta County and treatment was followed by similar response.

A disorder of pear fruits in El Dorado County was called to our attention in 1934 but it was not until 1944 in Placer County that the condition was clearly shown to be boron deficiency. Several dozen pear orchards are now known to be affected in the two counties.

### Symptoms of Boron Deficiency

The symptoms of olive and pear are similar in several respects. Yield is reduced, branches die back, much of the fruit drops prematurely—the olive early, and the pear late.

Affected fruits which remain on

the soil is the commonest method of treatment. Higher doses are occasionally required for cure but these should be used with great caution. This is definitely not a situation where "if a little is good more is better." Soil treatments usually supply the trees for about three years.

Spraying with borax, four pounds to 100 gallons of water, just after blossom time has the advantage of more rapid cure but the benefit is apparently for one season only.

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A chemical treatment of grasses consisting of sodium carbonate, sodium silicate, and glue has been found by the College of Agriculture's Division of Chemistry to be a weather-resistant fire-retarding agent for grasses.

## Quick Decline of Oranges

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This work has involved field, greenhouse, and laboratory experiments of many kinds to determine whether the disease was caused by an organism or a virus, or a combination of the two; whether it was due to a nutritional deficiency or excess; to an unbalanced physiological state; or incompatibility between the sweet top and certain strains of sour stock.

More complete observations were undertaken to determine whether or not soil moisture excess might be a factor.

Diseased trees were inarched to discover whether they could be saved by this means and also topworked to various citrus species.

An extensive series of rootstock trials has been started to learn more about stock tolerance to this malady.

Experiments to learn whether some soil toxin of biological origin might be involved were carried out.

Numerous experiments have been conducted to determine if fungi or bacteria are responsible.

Since in some respects this disorder resembled a virus disease, steps were taken to establish whether an insect carrier might be involved.

Further, experiments to transmit the disease by budding and grafting are under way.

### Certain Definite Findings

All of the nutritional studies point to something other than nutrition as the basic cause of quick decline.

One of the early findings was that in declining trees, starch had largely disappeared from the smaller roots. No such starch disappearance was found on healthy trees outside the decline area.

The probable reason for starch disappearance in roots of affected trees has emerged from anatomical studies of the conductive tissues at the bud union.

In trees affected with decline, a collapse of the phloem sieve tubes has been found consistently. It is through these tubes that sugar and other substances are transported from the top to the roots.

When the conductive tissue is impaired, sugar and other soluble substances do not move down to the roots in adequate amounts, the roots become devitalized, and thus are open to invasion by organisms.

### Replacement Recommended

Nothing suggestive of a cure for trees showing disease symptoms has come to light and the best practical solution at present is to replace these trees with trees budded on sweet stock.

## Agricultural Outlook

(Continued from page 1)

4.7 billion dollars to 10.2 billion dollars, while personal and collateral loans rose from 1.6 billion dollars to 3.9 billion dollars.

To the beginning of this year land owners who had been reducing their debts were more numerous than those who had been adding to their debts, with the result that total farm mortgage indebtedness shrunk. It is quite possible that 1946 will mark the low point in total farm mortgage for the country as a whole. In twenty of the states farm-mortgage debt has already turned upward. California is not one of those twenty states.

Farm land values are still rising. The index of values for the United States as of March 1, 1946, stood at 142 (1912-14=100), 58 points above that of 1940, but 28 points below the 1920 peak. In California, on the other hand, the index of land values on March 1 of this year was 98 points above that of 1940 and 52 points above the 1920 peak.

People who have bought farm land at these high prices are likely to get badly "burned", especially if they have gone heavily into debt to do so.

## Progress Reported in Search For Effective Control of Bovine Brucellosis

C. M. Haring

Results obtained by University of California veterinarians in cooperation with sixty-five dairy and beef cattle owners throughout this state over a period of several years, make it possible to announce an encouraging degree of success in the control of bovine brucellosis (Bang's disease, or infectious abortion) without resorting to the slaughter of valuable cattle.

By the use of freshly prepared and properly refrigerated *Brucella abortus strain 19 vaccine*, the incidence of brucellosis may be held down to a point where heavy losses from the slaughter of diseased cattle are un-

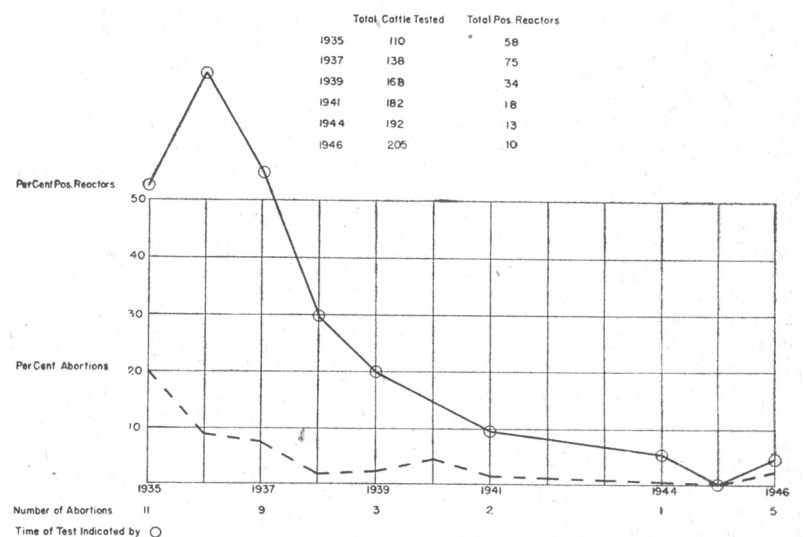
laboratory of the State Department of Public Health.

### Reactions to Vaccine

Vaccination can be injurious to undernourished or sick animals, but in healthy calves it produces only a mild and harmless reaction. Recently vaccinated calves give positive blood test results similar to those found in cattle infected with brucellosis. In a short time, however, this condition disappears, but the calves remain relatively resistant to infection.

In older cattle a stronger resistance is produced than in calves, and the blood remains positive to the agglu-

PERCENT OF POSITIVE REACTORS, PERCENT OF ABORTIONS IN HERD I, MARIN COUNTY



The above graph of reactors (diseased cattle) and abortions in a dairy herd during the past eleven years, illustrates the beneficial results to be expected from the use of BRUCELLA ABORTUS STRAIN 19 VACCINE in dairy herds badly infected with brucellosis. In 1935 the vaccine was used on all cattle regardless of age. During the following ten years, only the calves over four months of age were vaccinated. The occurrence of ten reactors and five abortions in 1946 is attributed to the purchase of some non-vaccinated cattle.

Calf vaccination against brucellosis is recommended for all dairy herds under present conditions in California, but adult cattle vaccination only in herds known to be badly infected.

necessary. The graph on this page is typical of benefits that are being obtained in cooperating dairy herds.

### Calf Vaccination Recommended

In certain beef herds the vaccination of yearling heifers each year for a period of several years has resulted in gradual increases in the calf crops. Brucellosis is still very prevalent in California dairy herds, however, but is relatively rare in beef herds. For that reason University veterinarians recommend all dairymen to practice calf vaccination, but do not advise going to the expense of vaccinating the heifers in beef herds unless the existence of brucellosis has been proven by blood tests. Many of the abortions in beef cows are caused by lack of vitamin A and other nutritional deficiencies and vaccine has no effect in reducing losses from such causes.

### Vaccine Must be Fresh and Potent

Cattle owners should make sure that the vaccine used on their animals is fresh and potent. Numerous tests have shown that over half the commercial vaccine serials secured from drug stores or distributed by peddlers in California were below government standard.

The labels on the vaccine bottles indicating that the vaccine was produced under government supervision indicates the vaccine was of acceptable quality at the time of production. However, good quality vaccine soon becomes impotent if not shipped and stored under proper refrigeration. For that reason the California State Departments of Public Health and Agriculture are cooperating in tests on all vaccine used in the official state program.

Veterinarians should be employed to select the animals suitable for vaccination and to administer the vaccine. Through them arrangements can be made for cooperation in the nation-wide Federal-State plan of brucellosis control. Through such cooperation vaccine can be purchased that has been recently tested for purity and viability at the

tinuation rest for a somewhat longer period. Veterinarians usually advise against the use of vaccine on older animals in herds that are free from brucellosis, but recommend its use on the calves after they reach the age of six months.

In badly diseased herds, the usual advice is for the vaccination not only of the calves, but also heifers and cows except those more than four months in calf. The injection of animals in advanced pregnancy may cause them to abort, therefore, in such cases vaccination should be postponed until after their calving.

### Vaccination Program

In many cases, it is not necessary to repeat the vaccination of any animal but the practice of vaccinating each calf when it reaches the age of six months should be continued over a period of years until blood tests show that the herd is free from brucellosis. Even then, continuance of calf vaccination in dairy herds is recommended as an insurance against possible losses resulting from the reintroduction of the disease.

The work of the Agricultural Extension Service in explaining to cattle owners the possibilities and limitations of vaccination against brucellosis has greatly helped in the suppression of the disease and the increased use of potent vaccine can now be expected to cause a rapid decrease of cattle brucellosis in California.

Information concerning the Federal-State plan for controlling brucellosis can be obtained from the Division of Animal Industry, State Department of Agriculture, Sacramento.

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Precision Planters of the horizontal and vertical plate types for accurate planting of small seeds such as sugar beets are under development by the Division of Agricultural Engineering.