Three weeks after applying a single foliage spray of ferric diethylenetriamine-pentaacetate to peach trees, the chlorosis had almost completely disappeared and the leaves have remained green until the present date.

These results indicate that control of lime-induced iron chlorosis in fruit trees is possible by soil treatment, providing sufficient iron chelate is used and it is transported to the absorbing roots by rain or heavy watering. The cost of adequate soil dressings of chelates may prove uneconomic on a commercial scale for certain fruit crops. For plums and peaches the foliage spray method appears to give a satisfactory control of chlorosis, during the season of application, at a much lower cost. Pear leaves are more difficult to wet and they are damaged more easily than plum, apple and peach.

The full results of these and of further experiments will be reported elsewhere.

C. Bould

Long Ashton Research Station,
Bristol.
Sept. 14.

[1] Jacobson, L., *Plant Physiol.*, **26**, 411 (1951).
[2] Stewart, I., and Leonard, C. D., *Citrus Mag.*, **14**, 22 (1952).
[3] Leonard, C. D., and Stewart, I., *Proc. Amer. Soc. Hort. Sci.*, **62**, 103 (1953).
[4] Chaberek, S., and Bersworth, F. C., *Science*, **118**, 280 (1953).
[5] Wallace, A., North, C. P., Kofranek, A. M., and Lunt, O. R., *Calif. Agric.*, **6**, 13 (1953).
[6] Bould, C., Ann. Rep. Long Ashton Res. Sta. 1953, p. 91.

Acarine Disease of the Honeybee and Temperature

It has been suggested from time to time that there may be relationships between acarine disease of honeybees and weather or other environmental factors; but such a view has also often received strongly reasoned opposition, as by Phillips[1] and Morgenthaler[2], and no reliable relationship with a weather factor has so far been forthcoming.

I have now found that if the areas between January isotherms for 27° F. and 54° F. actual temperatures in the northern hemisphere are shaded, upon a map of the world, and areas between July isotherms for 51° F. and 66° F. are shaded the other way upon the map, the two sets of shadings are found in superposition in Britain and adjacent parts of Europe, and the doubly shaded areas correspond fairly closely with the main areas in Europe in which acarine disease is found. Over the rest of the world (using the corresponding July and January isotherms respectively in the southern hemisphere) such overlap occurs only in a few limited areas. One of these areas is in Argentina, in which country acarine disease has been found. In North America—reported to have no acarine disease—there is no overlap except in a very limited area on the extreme west. Asia, in most areas substantially without acarine disease, and Africa and Australia, from which the disease has not been reported, show only very small localized areas of overlap.

The theory is advanced that acarine disease is found only where overlap of these two temperature bands occurs, and that the areas where the two bands cross most centrally (as in Britain) are the areas of highest infestation. New Zealand shows marked overlap, particularly in the south, and on this theory could harbour acarine disease if it were introduced, though so far the disease has not been reported from that country.

It is suggested that the action of high summer temperature in reducing the disease incidence is probably based on the faster working and shorter life-span of the worker bees which obtains under the more favourable foraging conditions, and which gives the mite less time to reach maturity and migrate from bee to bee; the low summer limit apparently coincides rather closely with the temperature limit for effective survival of the honeybee colony itself. The action of low winter temperature in reducing the incidence of disease may be partly due to the disturbed state of a diseased winter cluster, rendering it less able to survive the severe conditions of a cold winter; while the high winter limit may be principally a reflexion of the relatively high summer temperature which, for physical reasons, in temperate zones, apparently almost always accompanies it.

Many significant direct correlations between acarine incidence and temperature have been obtained in the course of this work; for example, a coefficient of $-0 \cdot 50$ (50 degrees of freedom, $P < 0 \cdot 001$) for acarine disease and summer temperature in fifty-two counties in England and Wales on data by Butler[3], and a coefficient of $+ 0 \cdot 51$ (20 degrees of freedom, $P < 0 \cdot 02$) for acarine disease and winter temperature for twenty-two years on data for Britain by Morison[4]; as well as highly significant correlations between incidence of acarine disease and January–July temperature-range, on either Butler's or Morison's data taken separately, and also between acarine disease and suitably selected phenological criteria on either of the above sets of data. It has been found that the above correlations with summer and winter temperatures can be drawn together mathematically into a single working hypothesis, which in operation corresponds closely with the overlap of the isotherm ranges suggested above.

Calculations based on this hypothesis, using temperatures prevailing in Britain in the appropriate years, agree with the timing of the severe epidemic of acarine disease in Britain between about 1904 and 1919, as well as the reduction in its incidence (evident in Morison's data) at the present time. They are also in agreement with the higher incidence of acarine disease in Scotland than in England (also seen in Morison's data) and, when calculations are based on temperatures in Switzerland, with the much lower incidence in that country (Morgenthaler[5]). The calculations show that at the temperatures of the major areas of North America, Africa and Australia, as well as most of Asia, the disease, on this hypothesis, would be unable to maintain itself.

I wish to thank Principal M. A. H. Tincker and Dr. G. D. Morison, of this College, for encouragement, Dr. F. H. C. Marriott, of the University of Aberdeen, for statistical advice, and Dr. C. B. Williams, of the Entomological Department, Rothamsted Experimental Station, for constructive criticism. Further details of this work will be published in due course.

E. P. Jeffree

Bee Research Department,
North of Scotland College of Agriculture,
Aberdeen.
Sept. 10.

[1] Phillips, E. F., U.S. Dept. Agr. Circ., **218**, 7 (1922).
[2] Morgenthaler, O., *Z. angew. Ent.*, **19**, 459 (1932).
[3] Butler, C. G., *Ann. App. Biol.*, **32**, 344 (1945).
[4] Morison, G. D., Jeffree, E. P., Murray, L., and Allen, M. D. (awaiting publication).
[5] Morgenthaler, O., *Beih. Schweiz. Bienenztg.*, **1**, 285 (1944).