BRIEF PAPERS

A VIRUS TECHNIQUE USEFUL TO DIAGNOSE FOLIAR DEFICIENCIES

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(WITH ONE FIGURE)

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Plants of Coffea dewevrei De Wild. et Th. Durant var. excelsa Chev. growing in nursery beds in a lath house at the Instituto Agronomico, Campinas, Brazil, exhibit frequently a type of chlorosis in the leaves (1).

Repeated attempts were made to improve the condition of the chlorotic plants by spraying their leaves with salt solutions of various elements, including iron, zinc, manganese, magnesium, etc. None of these treatments induced recovery of the normal green color, but it was noticed that some leaves of the plants sprayed with ferrous sulphate showed a few small islands of green tissue. The examination of these green areas revealed that they usually surrounded a point at which the leaf had been injured. This observation was suggestive that the chlorosis might be the result of iron deficiency in the leaves, and that the penetration of the iron solution in the tissues occurred only in the vicinity of points where the leaf had been injured.

Since a slight injury of the leaf was apparently beneficial for the penetration of the iron solutions in the leaves of the chlorotic coffee plants, it occurred to the writers that the use of carborundum as an abrasive (2) and the half-leaf technique might be good methods to be employed for the diagnosis of foliar deficiencies. The results obtained with this technique in the study of the chlorosis of the coffee plant were very satisfactory and indicate that its application might be useful also in leaf deficiencies of other plants.

Material and methods

Preliminary tests with various concentrations of ferric chloride and ferrous sulphate indicated that a 1% solution of either salt gave satisfactory results. The methods of applying the solutions and the untreated controls were compared by pairs, in all possible combinations, the position of each treatment being alternately on the left or right half-leaf. The treatments were distributed at random in regard to position of the leaves on the plants.

A de Vilbiss atomizer was used to apply the solution. The half-leaf not to be sprayed was protected with paper while the other half-leaf was sprayed. Rubbing was done in the manner common in virus studies, using a square pad of muslin cloth moistened in the solution to rub the half-leaf. When carborundum powder (600 mesh) was used, it was sprinkled on the leaf prior to rubbing. Care was exercised when rubbing to avoid damage.
to the leaf. The treatments were usually applied in the following order: spraying, rubbing, and rubbing with carborundum.

The reaction shown by the treated half-leaves and controls was graded in four classes according to degree of greening: no reaction, slight, medium, and strong reactions.

**Experimental results**

The results obtained in various tests comparing three methods of applying iron solutions to chlorotic leaves of the coffee plant are presented in table I. They indicate that the application of iron solutions with the atomizer was ineffective. Rubbing alone also gave poor results, whereas the use of carborundum greatly increased the proportion of half-leaves that turned green, and also the degree of the reaction (fig. 1). The greening of the treated half-leaves of the coffee plants was a slow process, taking from 10 to 30 days to become apparent. The effect of the treatment remained restricted.

**TABLE I**

**COMPARISON OF METHODS OF APPLYING SOLUTIONS OF IRON SALTS ON HALF-LEAVES OF CHLOROTIC COFFEE PLANTS.**

<table>
<thead>
<tr>
<th>Method of application</th>
<th>No. tested</th>
<th>Degree of greening shown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>Spraying</td>
<td>66</td>
<td>63</td>
</tr>
<tr>
<td>Rubbing</td>
<td>46</td>
<td>24</td>
</tr>
<tr>
<td>Rubbing with carborundum</td>
<td>135</td>
<td>2</td>
</tr>
<tr>
<td>Untreated control*</td>
<td>85</td>
<td>84</td>
</tr>
</tbody>
</table>

* In some tests the control half-leaves were rubbed with water or with salt solutions, carborundum also being used.

In some tests a comparison was made between the use of carborundum, followed by rubbing, on the upper side versus the under side of the half-leaves. The final results were apparently alike, but there was a slight indication that the application to the upper side of the leaf induced a quicker response.

**Discussion**

Spraying iron salts on chlorotic leaves of coffee plants induced practically no response, whereas the application of the same solutions followed by rubbing with carborundum resulted in a strong greening of the treated half-leaves. The use of the abrasive with water or solutions of other salts did not cause any reaction. These facts indicate that the penetration of
the iron solution was greatly favored by the slight mechanical injury caused by carborundum which probably permitted the penetration of the solution into the epidermal cells, followed by distribution to the underlying palisade cells of the leaf.

It is not known whether the application of solutions by rubbing with the help of carborundum will be more effective than spraying in the case of other plants. In preliminary tests not described in this paper, this technique was useful to diagnose deficiencies shown by citrus leaves. It is to be expected that the use of an abrasive will be more advantageous in tests diagnosing deficiencies in plants which possess a more impermeable cuticle, but the method might promote a quicker response to treatment even from plants which react to spray applications.

The results obtained with chlorotic coffee plants suggest that the application of iron salts, or perhaps salts of other elements on the leaves of orchard plants to correct symptoms of deficiency might be greatly helped if spraying is done with high pressure, by mixing an abrasive in the solution to be sprayed, or by other methods aimed at overcoming the resistance offered by the leaf against penetration of the solutions.

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