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College of Agriculture, A.P. Agricultural University, Hyderabad-30, India

An approach for predicting the occurrence of interveinal chlorosis in Anab-e-Shahi grape (Vitis vinifera L.)

by

S. D. Shikhamany[1]) and G. Satyanarayana

Versuch einer Prognose der Interkostalchlorose bei der Sorte Anab-e-Shahi

Zusammenfassung. — Um ein Kriterium für die Vorhersage der Interkostalchlorose in den verschiedenen Phasen der Beerenentwicklung von Anab-e-Shahi zu erarbeiten, wurde der Calcium- und Magnesium-Gehalt in den Blattstielen und Blattspreiten zur Zeit der Anthesis verglichen. Es werden Hypothesen formuliert, die mit 96%iger Wahrscheinlichkeit eine Prognose ermöglichen.

Introduction

Interveinal chlorosis followed by necrosis of the leaves in Anab-e-Shahi grape is very common in the Hyderabad region, one of the major centres of viticulture in India. Its occurrence is seen at different stages of fruit development. Though the leaves appear healthy during bloom, because of the hidden hunger they may turn chlorotic just at the fruit set, or at fruit maturity. Such symptoms are attributed by some authors to magnesium deficiency, e. g. Staehelin and Bovay (1956). Under limited supply of magnesium from the soil, developing fruits draw this element from the leaves, resulting in such deficiency symptoms (Camp 1947). Gärtel (1959) found more magnesium in the petioles than in the blades of leaves showing magnesium deficiency. Further, in a comparative study of the nutrient contents of petioles and leaf blades at bloom stage in Anab-e-Shahi grape it was found that a definite trend was observed with reference to nitrogen, phosphorus and potassium contents. In all the leaf samples, petioles had more phosphorus and potassium, whereas leaf blades had more nitrogen but with reference to calcium and magnesium contents the trend was irregular. In some samples, petioles had more and in the others the leaf blades had more (Shikhamany and Satyanarayana 1971). This variation in the comparative contents of these nutrients in petioles and leaf blades is used as a basis to evolve a criterion to predict the occurrence of this chlorosis. Such a prediction will help in preventing the chlorosis by suitable means.

Materials and Methods

For this study, 25 vineyards grown around Hyderabad under similar cultural practices were selected. Leaf samples were collected from these vineyards during full bloom stage (November, 1969), when the vines were apparently healthy. The calcium and magnesium contents were estimated separately in petioles and leaf blades, following the standard laboratory procedures. The performance of these vineyards with regard to the stage at which the chlorotic symptoms were visualised was recorded periodically. Based on this, the vineyards were grouped into three categories as follows:

[1]) Present address: Senior Research Assistant, Institute of Horticultural Research, Bangalore-6, India.

Table 1
Calcium and magnesium contents and their ratios (on dry weight basis) in the petioles (P) and leaf blades (B) of the vines showing chlorosis at different stages of fruit development

Sample No.	Observed status of chlorosis	% Ca		% Mg		$\frac{P\ Ca}{B\ Ca}$ (x)	$\frac{P\ Mg}{B\ Mg}$ (y)	$\frac{x^{1})}{y}$	Hypothetical status of chlorosis
		P	B	P	B				
1.	I	0.872	0.451	0.109	0.146	1.93	0.74		I
2.	I	0.721	0.691	0.146	0.255	1.04	0.57		I
3.	I	0.451	0.331	0.146	0.182	1.36	0.80		I
4.	I	0.541	0.301	0.109	0.164	1.80	0.66		I
5.	I	0.812	0.481	0.073	0.164	1.69	0.45		I
6.	I	1.020	0.962	0.073	0.219	1.06	0.33		I
7.	I	0.691	0.331	0.164	0.219	2.09	0.75		I
8.	I	0.481	0.391	0.146	0.201	1.23	0.73		I
9.	I	1.202	0.721	0.310	0.365	1.67	0.85		I
10.	I	0.872	0.631	0.201	0.237	1.38	0.85		I
11.	I	0.872	1.022	0.164	0.420	0.85	0.39	2.18	II
12.	II	0.721	0.481	0.146	0.128	1.50	1.14	1.31	II
13.	II	0.872	0.932	0.164	0.219	0.94	0.75	1.25	II
14.	II	0.752	1.022	0.164	0.255	0.74	0.64	1.16	II
15.	II	1.020	1.112	0.201	0.255	0.92	0.80	1.15	II
16.	II	0.872	1.082	0.182	0.365	0.81	0.50	1.62	II
17.	II	0.391	0.451	0.109	0.201	0.87	0.54	1.61	II
18.	III	0.451	1.413	0.164	0.201	0.32	0.81	0.40	III
19.	III	0.391	0.541	0.128	0.164	0.72	0.78	0.92	III
20.	III	0.812	1.473	0.146	0.201	0.55	0.73	0.75	III
21.	III	0.571	1.413	0.146	0.109	0.40	1.30		III
22.	III	0.631	0.812	0.146	0.146	0.78	1.00	0.78	III
23.	III	0.842	1.232	0.219	0.237	0.68	0.92	0.74	III
24.	III	0.511	0.631	0.164	0.146	0.81	1.12		III
25.	III	0.421	0.541	0.255	0.201	0.78	1.27		III

[1]) Gaps are there, wherever the values are evidently $>$ or $<$ 1.

I = No chlorosis even at fruit maturity.
II = Chlorosis observed at fruit maturity.
III = Chlorosis observed between full bloom and fruit set.

The ratios of petiole calcium to leaf blade calcium and that of petiole magnesium to leaf blade magnesium are worked out, and referred to as "x" and "y" respectively for the sake of convenience.

Observations

As shown in Table 1, eleven vineyards out of twenty five were found to be healthy. Chlorotic symptoms were not observed in them even at the fruit maturity stage. A close observation of the calcium and magnesium contents of petioles and leaf blades would reveal that petioles had more calcium than the leaf blades, but on the contrary, leaf blades had more magnesium than the petioles. In other words, when we consider in terms of "x" and "y", "x" is always greater than one and "y" is always less than one, thus keeping the ratio of "x" to "y" always greater than one. In rest of the vineyards either the "x" value is less than one or the "y" value is more than one.

When the ratios of "x" to "y" were worked out, it was found that in vineyards where the chlorotic symptoms were observed at the fruit maturity stage, it was always more than one. Six out of twentyfive were found in this category.

In the vineyards where chlorotic symptoms were noticed between full bloom and fruit set the ratio of x to y was found to be always less than one. Eight vineyards out of twenty-five fell in this category. In three of these vineyards it was further noticed that the value of "x" was always less than one, but simultaneously the "y" value was always more than one resulting in the ratio of "x" to "y" being always less than one.

Discussion

Magnesium requirements are higher during the fruit development stage when compared to the full bloom stage (GALLO and OLIVEIRA 1961). Under limited supply of this element from the soil, it might have translocated into fruits from the leaf blades. Petioles here are *via media*. When magnesium is translocated from the leaf blades into the fruits, there is every chance of calcium being translocated into the leaf blades from the petioles in order to maintain the ionic equilibrium in the leaf blades, as both of these elements are bivalent cations. Here it is worth mentioning that in every plant system there will be a definite proportion of cations and anions. Thus the total cation requirement in a plant system is a fixed one. Under such circumstances of magnesium translocation from leaf blades into fruits, the petioles will also go on accumulating magnesium and on the other hand they will in exchange be losing calcium which will be accumulated in leaf blades; thus the ratio of petiole calcium to leaf blade clacium goes on reducing, whereas the ratio of petiole magnesium to leaf blade magnesium goes on increasing. Finally when these ratios become less than one and more than one respectively the chlorotic symptoms might have been visualised.

Based on the above observations the following hypotheses can be formulated using Ca and Mg contents on a dry weight basis during the full bloom stage.

1. When the ratio (x) of calcium content of the petiole to that of leaf blade is more than one and simultaneously the ratio (y) of magnesium content of petiole to that

of leaf blade is less than one in a leaf sample of a vineyard the chlorosis would not appear even at fruit maturity stage in that vineyard.
2. When either the ratio x is less than one or the ratio y is more than one, chlorosis may be visualised either at the fruit set stage or during the fruit development.
3. If the ratio of x to y is less than one the chlorosis would appear at fruit set and if it is greater than one it would appear at the time of fruit maturity.
4. If the ratio x is less than one and simultaneously the ratio y is more than one, the chlorosis would occur just at the time of fruit set.

In light of these hypotheses the hypothetical status of chlorosis is worked out for the twenty-five vineyards surveyed. A comparison of the observed status of chlorosis and the hypothetical status of chlorosis of these vineyards (Table 1) would reveal that these hypotheses hold good in case of all the vineyards, except in sample No. 11, where the chlorosis was suspected during fruit development, but which actually was not observed even at fruit maturity. However the accuracy of prediction works up to 96 percent.

Summary

With a view to evolve a criterion to predict the occurrence of interveinal chlorosis of Anab-e-Shahi at different stages of fruit development, the calcium and magnesium contents of the petioles and leaf blades at full bloom stage were compared. Hypotheses were formulated, by which a 96 percent accuracy in prediction was made possible.

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S. D. Shikhamany
Inst. of Horticult. Research
255, Upper Palace Orchards
Bangalore 6
India