Vitis 17, 147—151 (1978)

Department of Plant Nutrition, Agricultural Faculty, Aegean University, Izmir, Turkey

The petiole and leaf blade relationships for the determination of phosphorus and zinc status of vineyards

by

I. Z. Atalay

Beziehungen zwischen Blattstiel und Blattspreite zur Beurteilung der Phosphor- und Zinkversorgung bei Weinreben

Zusammenfassung. — Zur Beurteilung der Phosphor- und Zinkversorgung von Reben wurden der Gehalt dieser Nährstoffe im Blattstiel und in der Blattspreite sowie die gegenseitigen Beziehungen dieser Elemente untersucht.

Es konnte eine statistisch gesicherte Korrelation (P = 1 %) zwischen Blattstiel und Blattspreite hinsichtlich des Phosphorgehaltes (r = 0,931**) und des Zinkgehaltes (r = 0,445**) aufgezeigt werden. Aus den Regressionsgeraden war zu entnehmen, daß Phosphor und Zink in den beiden Blatteilen dann in gleichen Mengen vorlagen, wenn der Gehalt an Phosphor 0,215 % und an Zink 43 ppm betrug.

Bei den mit Phosphor genügend versorgten Weinbergen zeigte die Blattspreite einen niedrigeren Phosphorgehalt als der Blattstiel, während bei ausreichender Zinkversorgung in der Blattspreite mehr Zink als im Blattstiel enthalten war. Im Falle der ungenügend versorgten Weinberge lagen zwischen den beiden Nährstoffen umgekehrte Beziehungen vor.

Introduction

For the last fifty years, many research workers have used plant analysis to determine the nutritional status of vineyards. Some of them used leaves (Levy 1968) and leaf blades (Beyers 1962) in their studies, whereas others gave importance to petioles (Loue 1968 a). Some also used the stems (Bergmann *et al.* 1958) and the cluster axises (Ismail *et al.* 1964) as materials for their analysis.

The research workers who used petioles for the determination of nutritional status of vineyards recommended phosphorus levels as 0.20 % (Forshey 1954, Larsen *et al.* 1956), 0.20—0.30 % (Loue 1968 b), 0.16—0.30 % (Cahoon 1970), and 0.14—0.39 % (Jung *et al.* 1971) for July and 0.10—0.30 % (Shaulis and Kimball 1956) for late August.

In the investigations dealing with zinc levels, 20 ppm for petioles (Cook 1966) and 14 ppm for young leaves (Marschner and Schropp 1977) were given as deficiency levels. Cahoon (1970) advised 30—50 ppm zinc as the recommended level for petioles in July.

Studies in the vineyards of Turkey (Atalay 1977, Kovanci *et al.* 1977, Kovanci and Atalay 1977) showed that the potassium and magnesium levels in the petioles were always higher than in the leaf blades and the nitrogen and calcium contents in the leaf blades were higher than in the petioles. Occasionally, phosphorus and zinc levels were found to be high in petioles as well as in leaf blades.

The present investigation is undertaken in order to have an idea of phosphorus and zinc levels in petioles and leaf blades along with their relationships with each other. In this type of studies Cook and Kishaba (1956) evaluated the petiole and leaf

blade levels and their ratios, whereas CARLES *et. al.* (1964) and SHIKHAMANY and SATYANARAYANA (1971) have given importance to petiole and leaf blade relationships in the determination of nutritional status of vineyards.

Materials and methods

Izmir and Manisa regions, having alluvial soils and Thompson Seedless grapes with American R-99 rootstocks, were selected for sampling. 96 samples were taken from different vineyards and each sample composed of 50 leaves collected opposite to the first cluster, during the fruit setting stage (beginning of June). Petioles and leaf blades were separated from each other. The samples were cleaned to remove dust and pesticide residues and dried at 65 °C. They were finally ground in a grinder and analyzed. After plant extracts were obtained by wet digestion (KACAR 1972), phosphorus was measured by vanado-molybdophosphorus yellow color method (LOTT *et al.* 1956) in the Eppendorf colorimeter. Zinc was measured in Varian AA-1200 atomic absorption spectrophotometer.

Results and discussion

The phosphorus content of the petioles ranges between 0.074 and 0.759 % and that of the leaf blades between 0.157 and 0.389 %. The petiole-P/leaf blade-P ratios were found between 0.47 and 1.95. In the phosphorus rich vineyards, the petiole-P content was found to be always higher than the leaf blade-P; therefore, petiole-P/leaf blade-P ratio was found to be greater than one. However, in the phosphorus

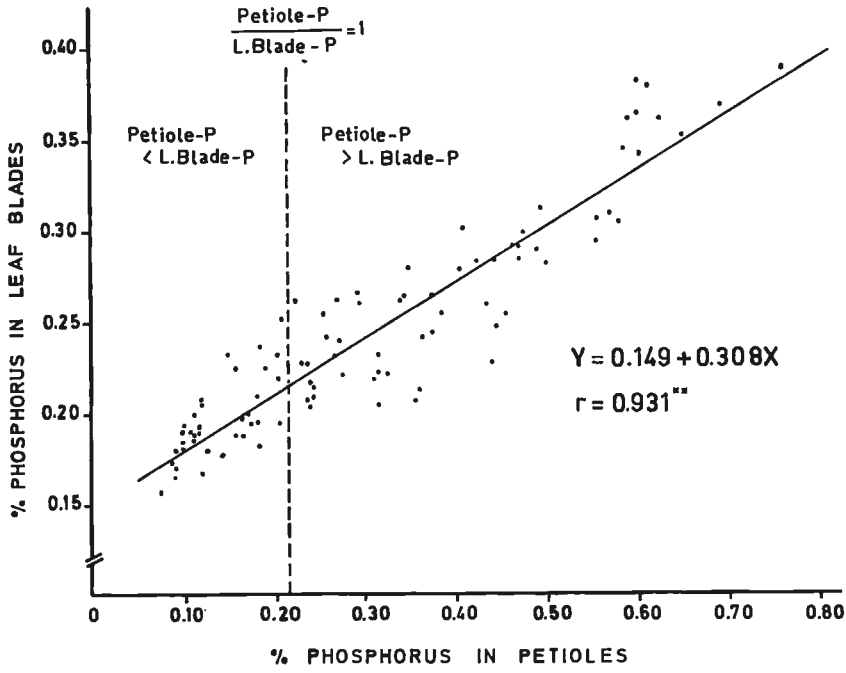

Fig. 1: The relationship between phosphorus contents of petioles and leaf blades.
Beziehung zwischen dem Phosphorgehalt des Blattstieles und der Blattspreite.

low vineyards, the opposite occurs. The petiole and leaf blade relationships, their correlation coefficient ($r = 0.931^{**}$), and the regression equation ($y = 0.149 + 0.308x$) are shown in Fig. 1. The regression line of this correlation intersects the leaf blade axis when x equals to 0, so it is evident that phosphorus accumulates firstly in the leaf blades. In this regression equation, x and y equals, when percentage phosphorus is 0.215. Up to 0.215 %, the petiole-P contents were lower than the leaf blade-P. When the petiole-P was more than 0.215, the leaf blade-P was found to be comparatively lower. These results are in close agreement to the findings of Cook and Kishaba (1956) and Shikhamany and Satyanarayana (1971). The 0.19 % phosphorus value established by these research workers as the balance point, differs a little from 0.215; this difference may be due to time of sampling.

The phosphorus value of 0.215, found as a result of this study, can be accepted as a standard value because it closely resembles the results of other investigations (Forshey 1954, Larsen *et al.* 1956, Loue 1968 b) dealing with phosphorus standard values for vineyards.

The petiole-Zn content ranges from 13 ppm to 83 ppm and leaf blade-Zn from 15 ppm to 308 ppm. The leaf blade-Zn/petiole-Zn ratios vary within the limits 0.33

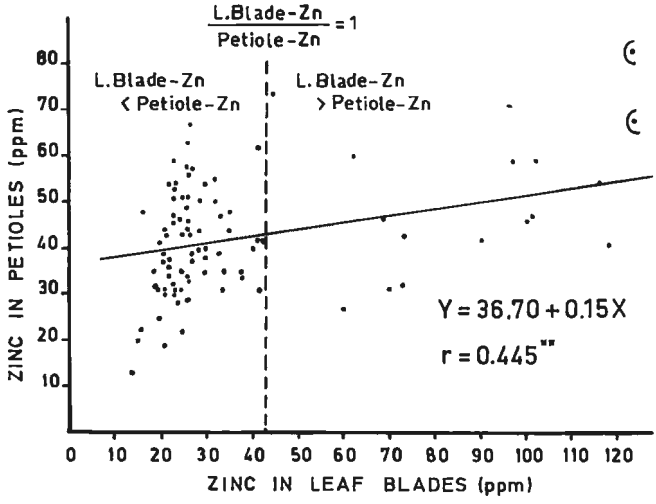

Fig. 2: The relationship between zinc contents of leaf blades and petioles.
Beziehung zwischen dem Zinkgehalt der Blattspreite und des Blattstieles.

and 3.71. The petiole and leaf blade relationships, their correlation coefficient ($r = 0.445^{**}$) and regression equation ($y = 36.70 + 0.15x$) are shown in Fig. 2. When x equals 0, this regression line intersects the petiole axis. In this regression equation, x and y equality occurs at 43 ppm. Up to 43 ppm, the leaf blade-Zn contents are lower than the petiole-Zn. Later, with increase of Zn, the contents in leaf blades correspondingly increase over the petiole-Zn values.

As a result in the phosphorus rich vineyards, the petiole-P content were found to be higher than those of the leaf blades. However, in the zinc rich vineyards, the leaf blade-Zn contents are higher than the petiole. Just the opposite situation happens in the vineyards poorly fertilized with P and Zn.

Summary

For the determination of phosphorus and zinc nutrition in vineyards, petiole and leaf blade relationships of these nutrients and their ratios were investigated.

Significant correlations were found at 1 % levels between the phosphorus contents in petioles and leaf blades ($r = 0.931^{**}$) and also between the zinc contents in leaf blades and petioles ($r = 0.445^{**}$). From the regression equations of these relationships, 0.215 % for phosphorus and 43 ppm for zinc were obtained as the levels at which petiole and leaf blade nutritional contents were equal to each other.

In the phosphorus rich vineyards, the petiole-P is higher than the leaf blade-P and in the zinc rich vineyards, the leaf blade-Zn is higher than the petiole-Zn. However, just the opposite situation happens in the poorly fertilized vineyards.

References

ATALAY, I. Z., 1977: The soil-plant relationships of nitrogen, phosphorus, potassium, calcium and magnesium as plant nutrients in vineyards of Izmir and Manisa region. E. Ü. Ziraat Fakültesi Yayin No. 345, 159 pp.

BERGMANN, E. L., KENWORTHY, A. L., BASS, S. T. and BENNE, E. J., 1958: A comparison between petiole and stem analysis of Concord grapes. Proc. Amer. Soc. Hort. Sci. 71, 177—182.

BEYERS, E., 1962: Diagnostic leaf analysis for deciduous fruit. S. African J. Agricult. Sci. 5, 315—329.

CAHOON, G. A., 1970: Survey of foliar content of American and French hybrid grapes in fourteen research-demonstration vineyards in Southern Ohio. Res. Summ. Ohio Agricult. Res. Dev. Cent. 44, 24—27.

CARLES, J., BOUFFARD, A. A. et MAGNY, J., 1964: De l'influence du pétiole sur la composition du limbe de la feuille de vigne. Le contrôle de la nutrition minérale et de la fertilisation des cultures méditerranéennes. I. Colloq. Eur. Medit., Montpellier, 1964, 171—173.

COOK, J. A., 1966: Grape Nutrition. In: CHILDERS, N. F. (Ed.): Fruit Nutrition, 778—812. Somerset Press, Inc. Somerville, N. J.

— — and KISHABA, T., 1956: Using leaf symptoms and foliar analyses to diagnose fertilizer needs in California vineyards. In: PREVOT, P. (Ed.): Analyse des Plantes et Problèmes des Fumures Minérales, 158—176. I.R.H.O., Paris.

FORSHEY, C. G., 1954: A study of some of the factors affecting the yield and fruit quality of Concord grapes (*Vitis labrusca*). Ph. D. Thesis, Ohio State Univ.

ISMAIL, Z., HABEEB, H. and EL-WAKEEL, A. T., 1964: Further evaluation of the relationship between N, P and K composition of the cluster axis and the nutritional status of the grapevine. Agricult. Res. Rev., Cairo, 42, 1—18.

JUNG, S. M., IM, Y. J. and LEE, K. Y., 1971: Studies on the nutritional diagnosis of Korean grapevines by means of leaf analysis. Res. Rept. Office Rural Develop. (Hort.) (Suwon) 14, 57—64.

KACAR, B., 1972: Chemical plant and soil analysis. II. Plant analysis. A. Ü. Ziraat Fakültesi Yayinlari No. 453, Uygulana Klavuzu No. 155. A. Ü. Basimevi, Ankara, 646 pp.

KOVANCI, I., AGME, Y. and ATALAY, I. Z., 1977: The status of macro nutrient elements and soil-plant relationships of Çal vineyards. Bitki 4, 192—212.

— — and ATALAY, I. Z., 1977: An examination of nutrition status of Alaşehir vineyards by leaf analysis method. E. Ü. Ziraat Fakültesi Dergisi 14, 119—129.

LARSEN, R. P., KENWORTHY, A. L., BELL, H. K., BASS, S. T. and BENNE, E. J., 1956: Nutritional conditions of Concord vineyards in Michigan. I. Nutrient-element content of petioles in relation to production. Mich. State Univ. Agricult. Exp. Sta. Quart. Bull. 39, 63—70.

LEVY, J. F., 1968: L'application du diagnostic foliaire à la détermination de besoins alimentaires des vignes. Le contrôle de la fertilisation des plantes cultivées. II. Colloq. Eur. Medit., Sevilla, 1968, 295—305.

LOTT, W. L., NERY, J. P., GALLO, J. R. and MEDCAFF, J. C., 1956: Leaf analysis technique in coffee research. IBEC. Res. Inst. II. 9, 21—24.

LOUE, A., 1968 a: Essais sur vignes du gers. Etudes sur la nutrition et la fertilisation potassique de la vigne. Société Commerciale des Potasses d'Alsace Services Agronomiques, 1968, 23—29.

— — , 1968 b: Diagnostic pétiolaire de prospection. Etudes sur la nutrition et la fertilisation

potassique de la vigne. Société Commerciale des Potasses d'Alsace Services Agronomiques, 1968, 31—41.

MARSCHNER, H. und SCHROPP, A., 1977: Vergleichende Untersuchungen über die Empfindlichkeit von 6 Unterlagensorten der Weinrebe gegenüber Phosphat-induziertem Zink-Mangel. Vitis 16, 79—88.

SHAULIS, N. and KIMBALL, K., 1956: The association of nutrient composition of Concord grape petioles with deficiency symptoms, growth and yield. Proc. Amer. Soc. Hort. Sci. 68, 141—156.

SHIKHAMANY, S. D. and SATYANARAYANA, G., 1971: Comparative study of petiole and leaf blade analyses in Anab-e-shahi grape (*Vitis vinifera* L.). Indian J. Hort. 28, 264—269.

Eingegangen am 10. 10. 1977

Dr. I. Z. ATALAY
E. Ü. Ziraat Fakültesi
Bitkibesleme Kürsüsü
Bornova-Izmir
Turkey