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Is there an influence of inorganic nutrition on the susceptibility of the pistachio to *Camarosporium pistaciae*?

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Abstract. Based on our observations that in the same pistachio orchard the percentage of the infected panicles by *Camarosporium pistaciae* was greater in the higher yielded trees compared to the lower ones, we investigated the possible effect of tree nutritional status on the infection intensity. Our study was carried out in two different areas of Greece, Thiva and Fthiotida (Central Greece), for three successive years. In the first year, leaf and soil samples were collected from the two aforementioned tree cases, in two severely infected orchards, in Thiva. According to leaf analysis results for N, P, K, Ca, Mg, Fe, Mn, Zn, Cu and B, the only concentration that was significantly differentiated was that of K; K level in the leaves of higher yielded trees with greater percentage of infection was significantly lower than that in the leaves of lower yielded trees with lower percentage of infection. In the following year, in order to examine the effect of K fertilization on disease intensity, we applied increased quantities of K fertilizer in some pistachio trees whereas no K fertilizer was added in other ones; leaf and soil analysis of +K fertilized trees presented higher K values compared to –K trees but the environmental conditions in the area were unfavorable for the disease development. In the third year, leaf and soil analysis were also performed in another severely infected orchard in Fthiotida; at the end of May, leaves upwards of the more severely infected panicles and leaves upwards of the less severely infected ones were collected for analysis; among all the nutrient elements determined, no significantly differentiated concentration was found between the two cases whereas the level of the nutrient elements in the soil was found to be between the sufficiency ranges. So far, the results of our investigation concerning the influence of pistachio inorganic nutrition on *C. pistaciae* development have been controversial. The investigation will be continued by growing potted trees with various K levels in hydroponics in combination with their artificial inoculation by C. pistaciae.

Keywords. *Camarosporium pistaciae* – Pistachio – *Pistacia vera* – Potassium.

***Existe-t-il une influence de la nutrition inorganique sur la sensibilité du pistachier à* Camarosporium pistaciae ?**

Résumé. *Sur la base de nos observations montrant que dans le même verger de pistachiers, le pourcentage de panicules infectées par* Camarosporium pistaciae *était plus grand dans les arbres à forte production par rapport aux moins productifs, nous avons étudié l'effet possible de l'état nutritionnel des arbres sur l'intensité de l'infection. Notre étude a été menée dans deux zones différentes de la Grèce, Thiva et Fthiotida (Grèce centrale), sur trois années successives. Pour la première année, des feuilles et des échantillons de sol ont été recueillis sur des arbres à forte et à faible production, dans deux vergers gravement infectés, dans la zone de Thiva. Selon les résultats de l'analyse des feuilles concernant N, P, K, Ca, Mg, Fe, Mn, Zn, Cu et B, la seule concentration qui était nettement différenciée était celle de K ; le niveau de K dans les feuilles des arbres à rendement plus élevé avec un plus grand pourcentage d'infection était significativement plus faible que dans les feuilles des arbres moins productifs et à plus faible pourcentage d'infection. L'année suivante, afin d'examiner l'effet de la fertilisation en K sur l'intensité de la maladie, nous avons appliqué une augmentation de la quantité d'engrais de K dans certains pistachiers alors qu'aucun engrais de K n'était ajouté aux autres ; l'analyse des feuilles et du sol des arbres fertilisés +K a présenté des valeurs de K supérieures par rapport aux valeurs des arbres -K, mais les conditions environnementales dans la région étaient défavorables pour le développement de la maladie. En troisième année, les feuilles et les analyses de sol ont également été effectuées dans un autre verger gravement infecté à Fthiotida ; à la fin mai, les feuilles au-dessus des panicules les plus gravement infectées et les feuilles au-dessus des moins sévèrement infectées ont été recueillies pour analyse ; parmi tous les éléments nutritifs déterminés, on n'a pas trouvé de concentration sensiblement différente entre les deux cas, tandis que le niveau des éléments nutritifs dans le sol a été jugé suffisant. Jusqu'à présent, les résultats de notre enquête sur l'influence de la nutrition inorganique du pistachier sur le développement de*

C. pistaciae *ont fait l'objet de controverses. L'enquête sera poursuivie par la croissance des arbres en pot avec différents niveaux de K hydroponique en combinaison avec leur inoculation artificielle par* C. pistaciae*.*

Mots-clés. Camarosporium pistaciae – *Pistache* – Pistacia vera – *Potassium.*

I – Introduction

Panicle and shoot blight caused by *Camarosporium pistaciae* has been a severe disease of the pistachio in Greece, in recent years. In 2002 and to a lesser extent in 2004, the fungus caused severe losses of pistachio production in several areas. The first symptoms of the disease appeared in May as small round black lesions on the young fruits; infections were also observed at the rachis of the panicles, the leaves and the shoots. In July or early in August, part of, or the entire panicle, leaves and shoots were killed by the fungus. In some orchards, up to 80% of panicles were found to be affected. The determinant factors for the disease development were the long lasting rainfalls in combination with the high temperature that prevailed in August, soon before the harvest.

In several infected pistachio orchards, it was observed that the percentage of the infected panicles was greater in the higher yielded trees compared to the lower ones (Assimakopoulou *et al.*, 2006).

The fact that mineral nutrition can exert a profound effect on disease development (Marschner, 1997), as well as, the great deal of information available in the literature on the effects of nutrition on disease development in several crops (Walters and Bingham, 2007), has led to speculation regarding the possible role of inorganic nutrition on disease intensity.

II – Materials and methods

The study was conducted for three successive years, in commercial orchards severely infected by *Camarosporium pistaciae*. They consisted of pistachio trees var. Aegina grafted onto *Pistachia terebinthus* cv Tsikoudia rootstock, in two different areas, Thiva and Fthiotida, of Central Greece. Leaf and soil chemical analyses were carried out as following:

Leaf samples were washed, dried to constant weight and dry-ashed in a furnace at 500^0C; the dry digest had been extracted in HCl. The concentration of P was determined by vanado-molybdo-phosphate yellow color method, B by azomethin-H, K by flamephotometry and Ca, Mg, Fe, Mn, Zn and Cu by atomic absorption spectrometry, in the dry digest whereas N was determined by the indophenol-blue method in the wet digest.

Soil samples were air-dried at room temperature, crushed to pass a 2-mm sieve and the following were determined: Saturation percentage (SP%), EC (mS/cm), pH in saturation paste, soluble K (meq/L), P (Olsen) (ppm), exchangeable Ca, Mg, K and Na (ammonium acetate method) (meq/100 gr soil).

III – Results and discussion

In the first year (2002), leaf and soil samples were collected: (i) from higher yielded trees with a greater percentage of infected panicles; and (ii) from lower yielded trees with a smaller percentage of infected panicles, in two severely infected orchards in Thiva, in September. Every leaf sample consisted of sub-terminal leaflets of leaves from non bearing branches whereas each soil sample was composed of a pool of sub-samples taken under the tree canopy from each case, at a depth 3-40 cm.

The soil of both orchards was classified as clay, alkaline, with 2% total CaCO3, 3% organic matter and normal EC. The exchangeable K concentration was high, Mg in excess, Fe, Mn, Zn and Cu levels sufficient and B low.

Among N, P, K, Ca and Mg determined, in both orchards K level in the leaves of higher yielded trees with a greater percentage of infection was found to be significantly lower than that in the leaves of lower yielded trees with a lower percentage of infection (Fig.1) despite the fact that K level in the leaves of thrifty trees should be expected to be higher than in the unthrifty ones (Uriu and Crane, 1977); K is also reported to decrease the severity of Verticillium wilt in pistachio trees (Ashworth, 1986).

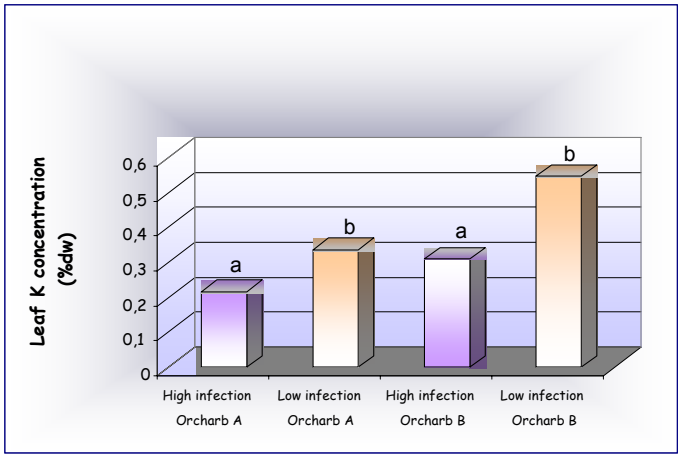

Fig. 1. Leaf K concentration (% dw) of higher-yielded trees with greater percentage of infection and of less-yielded trees with lower percentage of infection, in two orchards (A, B), in Thiva.

Among the micronutrients Fe, Mn, Zn, Cu and B, only leaf Boron concentration in the case of higher yielded trees with a greater percentage of infection was found to be lower, in the one orchard; however, B is expected to be lower in the thrifty trees than in the unthrifty ones.

In the second year, in order to examine the effect of K level on disease intensity, we applied increased quantities of K fertilizer to ten pistachio trees whereas no K was added to another ten, in both orchards in Thiva. Specifically, 3 kg Patentkali (0-0-30) per tree in winter, 5 kg soluble K_2SO_4 (0-0-50) per tree by fertigation in mid June and two K foliar sprays (one at the end of June and the next one in mid July) were applied.

Soil analysis performed before the fertilizer application showed that soil exchangeable K was within the sufficiency range but soil Mg was in excess. Despite the great quantities of K added, leaf K concentration of +K trees was higher than that of –K trees, however, the difference was not significant; it should be due to the high level of soil Mg that impaired K uptake by plants (strong K-Mg antagonistic relationship) (Table 1). Besides, the environmental conditions were unfavourable for the disease development, so it was not possible to examine the effect of the increased K fertilization on disease intensity.

In the third year (2004), the study was continued in Fthiotida, a more rainy area, with a great number of pistachio orchards severely infected by the fungus. In order to examine the possible nutritional differentiation between the leaves above the more severely infected panicles and the leaves above the less severely ones, appropriate leaf and soil samples were collected at the end of May.

Among all the nutrient elements determined, no significant differences were found between the two cases except leaf P concentration that was significantly higher in the more severely infected panicles (Fig. 2). The levels of the nutrient elements in the soil were found to be within the sufficiency ranges with a better K-Mg ratio in this orchard (Table 2).

Table 1. Soil analysis results under the +K tree canopies and the -K tree canopies, in one orchard, in Thiva

	With K fertilizer	With no K fertilizer
Saturation percentage (%)	75	76
pH (saturation percentage)	7.6	7.8
EC (mS/CM)	1.6	1.0
Soluble K (meq/l soil extr.)	0.20	0.10
Excheable Ca (meq/100 gr)	17.5	18.8
Excheable Mg (meq/100 gr)	18.1	17.6
Excheable K (meq/100 gr)	1.5	0.9
Excheable Na (meq/100 gr)	0.6	0.5
P (Olsen) (ppm)	31	21

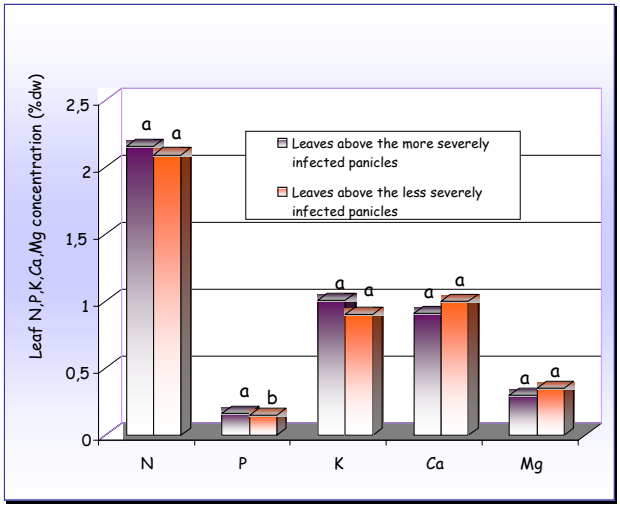

Fig. 2. Leaf N, P, K, Ca and Mg concentration (% dw) in the pistachio orchard, in Fthiotida.

IV – Conclusions

In our study the greater disease resistance of pistachio trees to *Camarosporium pistaciae* was suspected to be related primarily to higher leaf K concentration.

However, the results of our investigation have not been consistent; it should be due to the complexity of interactions between nutrition and plant disease which are dependent on many factors.

Additional experiments need to be performed until any of the findings could be adapted in the field. Therefore, the investigation will be continued by growing potted trees with various K levels in hydroponics, artificially inoculated by *C. pistaciae*.

Table 2. Soil analysis results in the orchard in Fthiotida

Saturation percentage (%)	38.0
pH (saturation percentage)	7.6
EC (mS/CM)	1.8
Soluble K (meq/l soil extr.)	1.7
Excheable Ca (meq/100 gr)	14.8
Excheable Mg (meq/100 gr)	3.9
Excheable K (meq/100 gr)	0.8
Excheable Na (meq/100 gr)	0.3
P (Olsen) (ppm)	23.0

References

Ashworth L.J.Jr., Morgan D., and Surber E., 1986. *Vertcillium* wilt of pistachio. In: *California Agriculture*, July-August, p. 21-24.

Assimakopoulou A., Elena K., Vlachoyannis D. and Georgopoulos V., 2006. Susceptibility of pistachio (*Pistacia vera* L.) to *Camarosporium pistaciae* in relation to the tree nutrient status. Summaries of papers presented at 12th Hellenic Phytopathological Congress, Kastoria, Greece, October 12-15, 2004. In: *Phytopathologia Mediterranea,* 45, p. 183.

Marschner H., 1997. *Mineral nutrition of higher plants*. 2nd edition. Academic Press. London.

Uriu K. and Crane, J.C., 1977. Mineral element changes in pistachio leaves. In: *Journal of the American Horticultural Science*, 102, p. 155-158.

Walters D.R. and Bingham, I.J., 2007. Influence of nutrition on disease development caused by fungal pathogens: Implications for plant disease control. In: *Annals of Applied Biology*, 151, p. 307-324.