AVOIDING CONFUSIONS BETWEEN THE VISUAL SYMPTOMS OF THE PLANT NUTRIENT DISORDERS AND BETWEEN THESE AND THOSE DETERMINED BY OTHER CAUSES: *b) MICRONUTRIENTS*

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Abstract. *Beside the first paper from the series, the one referring to macronutrients, this paper brings new and important contributions regarding the diagnosis of the micronutrient disorders of plants by visual symptoms. Many confusions can appear between different nutrients, between their symptoms and those produced by diseases, pests, pollution etc. The paper presents how to discriminate between: B deficiency and peach rosette mosaic virus (PRMV) disease in grapevines; Fe an Mn deficiencies; Mn and Mg deficiencies; Mn deficiency and pest symptoms, like Trialeurodes vaporarium, and many others. The given explanations allow put a right diagnosis concerning the nutrition. In the limited area of the paper, a series of original images is also presented.*

INTRODUCTION

See the first paper from the series: "Avoiding confusions between the visual symptoms of the plant nutrient disorders and between these and those determined by other causes: a) Macronutrients".

MATERIAL AND METHOD

See the first paper from the series: "Avoiding confusions between the visual symptoms of the plant nutrient disorders and between these and those determined by other causes: a) Macronutrients".

RESULTS AND DISCUSSIONS

B deficiency. It *appears first on plants' growing points and young leaves* from the tips of yearly shoots, stem or center of the leaf rosette. *The apical buds die*, similar to Ca and Cu deficiency. The young leaves stop growing, distort, curl, sometimes twist, become fragile, unregular chloroses appear between the veins and, finally, they brunish or blackish. The leaves from the center of the leaf rosette, like in beet, rott and the rottenness penetrates the root.

Confusions with Ca deficiency and their avoidance. In the case of Ca the shoot's tissue softens underneath the flower or inflorescence (in *Umbeliferae* the peduncles of the flowers from umbella softens) and it breaks and bends, phenomenon named *"benting down"*, and the fruits of some *Solanaceae* (tomato, pepper) and of some *Cucurbitaceae* (watermelon) present "blossom end rot", which does not happen to B. For other details, see Budoi, 2001.

Confusions with diseases and their avoidance: *Peach rosette mosaic virus (PRMV) disease in grapevine.* The symptoms determined by B deficiency in grapes can be confused with those produced by *PRMV*. B deficiency determines the so called "hen and chicken disease", or "sheep and lambs disease", the cluster presenting just some big, normal berries, the others being small. Berry cluster shelling occurs on vines that have been infected with PRMV for several years, and it is to be noted the small fruit cluster (D.C. Ramsdell, 1994) (fig. 1). The leaves' distortion determined by B can also be confused with those produced by virus.

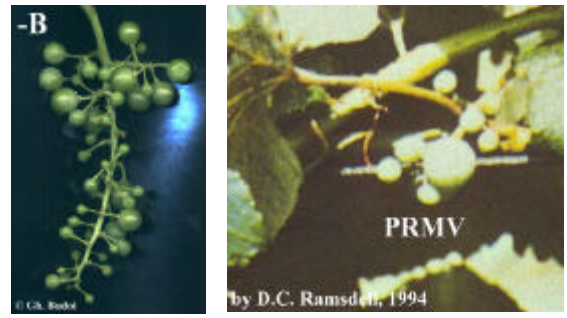


Fig. 1. Similarity between B deficiency – left (original image Gh. Budoi) **and peach rosette mosaic virus (PRMV) disease in grapevines – right** (image by D.C. Ramsdell, 1994)

B deficiency differentiates from virose by the fact that the buds dye, the shoots growing points die, the internodes get thicker and the cluster's rachis grow normally, it does not remain short. PRMV infected vines are usually umbrella-shaped because the virus causes the canes to grow somewhat crookedly, internodes are shorter than normal; where the disease exists, there are "holes" in the vineyard (D.C. Ramsdell, 1994). To avoid confusions with other diseases, see Budoi, 2001.

Fe deficiency. It *appears first on younger leaves* from the tips of stem or shoots, and extends towards those from base. It determines the *undistorting chlorosis* of the leaves, but they do not wilt and they usually do not present necrosis. The leaves get yellow-green tints between veins, then these zones become yellow, limonish-yellow or even yellowish-white (fig. 2). *The main veins*, and frequently also those of second and third order, *remain green* (without presenting green band along them, like in Mg or Mn deficiency) in contrast with the light background of the rest of lamina, giving a *reticualr appearance*, and in advanced stages the main green veins give an stylized tree appearance. In severe cases, the chlorosis includes the main veins too, the leaves' discoloration getting to whitish tints. If the deficiency appears in the first stages of vegetation and then the available soil Fe content and plant nutrition normalize, because of the very low mobility of Fe within the plant, the symptoms maintain especially in more advanced stages of vegetation, in which the deficiency is now observed on older leaves from the base of plant or yearly shoots, proceeded from the young ones on which it appeared. When the soil Fe content normalizes, the leaf regreens gradually, in the same way on all lamina's surface, opposed to the case when it is chlorosed. So, the deficiency can be seen on older leaves after a certain period of time from the nutrition's normalization, without being observed on young leaves. This must not lead to confusions and such an old deficiency must be recognized.

Confusions with Mg deficiency and their avoidance. In Fe deficiency the symptoms appear and are more prominent on the leaves from top of shoots or stem, while in Mg they are on older leaves, from base. In trees, in Fe, *defoliation* of the yearly shoots' tips can occur, while Mg deficiency defoliates their base ("brush disease"). When Fe deficiency occurs, leaf necrosis do not usually appear, but in Mg they usually do. In Fe only the veins remain green, in Mg a band along them remains also green ("vein banding").

Confusions with Mn and Mo deficiency. Fe deficiency in tomatoes differentiates from that of Mn (see Bergman, 1992, fig. 698 and 696) and from that in Mo by the fact that, to Fe, the chlorosis begins from the tip and margins of the leaflet (see Bergman, 1992, fig. 626), in Mn it begins from its base and center (see Bergman, 1992, fig. 507), and in Mo the chlorosis is relatively uniform on all the leaflet (see Bergman, 1992, fig. 507). For other details, see Mn deficiency below.

Fig. 2. **Fe deficiency in apricot – *Prunus armeniaca*, spiraea – *Spiraea douglasii*, gerbera – *Gerbera jasminoides*, and gardenia – *Gardenia jasminoides*** (original images, copyright Gh. Budoi)

Confusions with Mg deficiency and with diseases and pests attacks: see Budoi, 2001.

Mn deficiency. Similar to Fe and opposed to Mg, the symptoms appear first on young leaves from tip and extend towards the base of shoots or stem. Mn is a little bit more mobile than Fe. In *Dicotiledinatae* interveinal chlorosis appear, the nerves and a band along them – "vein banding" (narrower and more uniform in width than in Mg), remain green (fig. 3). Especially in first stages, the veins of first, second and even of third order remain green. The chlorosis are followed by necrosis in points and small spots or blotches, rust-coloured or brown, dispersed on the entire leaf, which can join and perforate because of wind and rain.

Confusions with Fe deficiency and their avoidance. They appear for example in sweet cherry tree. Even if to both nutrients the symptoms appear first on young leaves, from tip, and they are very much alike, there are differences too. In Mn, besides the veins, a band with a relative equal width along the veins also remain green, while in Fe only the veins remain green. In advanced stages, Mn leads to leaf necrosis, and sometimes to lamina's perforations, which usually do not occur in Fe. However, in *Gerbera jamesonii* the severe Fe deficiency determines yellowish-brown and brown necrosis, but these are continuous and they progress beginning from the leaf border, while in Mn they are in points and small spots disseminated on the entire leaf.

Fig. 3. **Mn deficiency in quince - *Cydonia oblonga*** (original image, copyright Gh. Budoi)

Confusions with Mg deficiency and their avoidance. They can appear especially in runner bean and in some apple tree varieties. The fundamental difference is that in Mn the symptoms appear first from shoot's tip and are more prominent on younger leaves, and to Mg they appear from base and on the older leaves. In Mn defoliation of yearly shoots do not occur in fruit trees, while Mg deficiency defoliates their base. In Mn the green band along the veins is narrower then in Mg, and generally more uniform as width, while in Mg the band gets narrower much from the veins' base towards their tips. Furthermore, in Mg the necrosis are large blotches, elongated between veins, which usually begin from the border of the leaf, while in Mn they are in points and small spots spread relatively uniformly on the entire leaf.

Confusions with pest attack. The attack produced by glasshouse white midge – *Trialeurodes vaporarium*, peach green loose – *Myzodes persicae*, syn. *Aphis persicae*, and accarians – *Tetranychus urticae*, all pollyphagous species, can determine visual symptoms in some plant species, like pepper – *Capsicum annuum* (fig. 4), which at first sight can be confused with those of Mn deficiencies (fig.3). The careful observation of dorsal side of leaf eliminates the confusions by the presence of pests, of prick traces on it etc. In the case of *Trialeurodes vaporarium*, with a magnifying glass, and even with the eyes, the insects' exuviae can be observed,

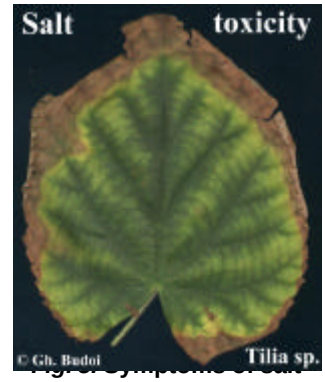
Fig. 4. **Visual symptoms of the complex attack of *Trialeurodes vaporarium*, *Myzodes persicae* (syn. *Aphis persicae*), and *Tetranychus urticae* in sweet pepper, which can be confounded (left, ventral face) with Mn deficiency** (original images, copyright Gh. Budoi)

and sometimes even dead insects on which parasites parasitated, on an end being seen the small hole through which the parasite exit the guest.

Myzodes persicae, which attacks not only the peach tree, but also other stone fruit trees, as well as pepper, tomatoes, eggplants, determines the twisting, yellowing and drying of the leaves (Pasol, 1980, Rosca, 2001); the twisting does not occur in the case of Mn deficiency, which differentiates also the two causes. In the case of sucking insects, and especially of accarian, after the sap's sucking from the cells, in its place enters the air which favors the oxidation of some cell compounds, Fe most probably, and the redness and browning of the tissue, and finally its drying.

Zn deficiency. The chlorosis between the main veins, which appear in Zn deficiency in lemon and orange tree, are very much alike those produced by *Mg deficiency*. The difference consists in the fact that in Zn the symptoms appear first on younger leaves from the tip of yearly shoots, and in Mg they appear on older ones from their base. More, in Zn the "little leaf" and shortnodding occur. Zn deficiency in some sweet cherry varieties is very much alike Fe deficiency, from which it differs by the "little leaf" and "rosetting" phenomena.

Salt (NaCl) toxicity and confusion of its symptoms with those of Mg or K deficiency. In some species, like linden tree – *Tilia* sp., chestnut tree – *Aesculus hippocastanum*, planted along the streets and roads, because of the salt used to thaw the snow, the ice or gleized frost in winter, salt which accumulates much more by pushing the snow (charged with salt) beyond the kerb, symptoms that can be confused with Mg or K deficiency appear (fig. 5). Thus, interveinal chlorosis appear, like in Mg, and brown and reddish brown necrosis which progress uniformly from borders towards the center of lamina, like in K, the necrosed area being separated from the sill green area by a gold-yellow chlorosing zone, more or less developed, which does not exist in K; in K deficiency interveinal chlorosis do not occur, and in Mg the necrosis penetrate between the main veins. Another difference between salt toxicity and nutritional deficiencies is the fact that the symptoms are not localized in salt toxicity, but they are spread on all the leaves of a yearly shoot. The simple analyze of soil salt content by comparison with a soil sample from normal trees also shows if it is salt toxicity or not. The soil sample must not be taken after rain, which can leach the soluble salts in depth, but after many days of hot and dry weather. For details concerning salt toxicity in other species, see Budoi, 2001.



(NaCl) toxicity in linden tree – *Tilia* sp. (original image, copyright Gh. Budoi)

CONCLUSIONS

The diagnosis of the nutrient disorders by visual symptoms is the first method available in plant production, the most rapid, the cheapest, allowing take immediately correction measures.

Many confusions can appear between different nutrients, between their symptoms and those produced by diseases, pests, pollution etc. The paper presents how to discriminate between: B deficiency and peach rosette mosaic virus (PRMV) disease in grapevines; Fe an Mn deficiencies; Mn and Mg deficiencies; Mn deficiency and pest symptoms, like Trialeurodes vaporarium, and many others. The given explanations allow put a right diagnosis concerning the nutrition.

In the limited area of the paper, a series of original useful images are presented.

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