

# Toxicidade de boro em videiras ‘itália’ (*Vitis vinifera* L.)

## Toxicity from boron in ‘Italia’ (*Vitis vinifera* L.) Grapevines

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### Resumo

No Noroeste do estado de São Paulo, em muitos vinhedos da cultivar Itália, foi verificada uma anomalia nas folhas das plantas caracterizada por sintomas de clorose, crestamento e enrolamento dos bordos. Com o objetivo de comprovar a hipótese de que a anomalia estaria associada a excesso nutricional devido à aplicação em quantidade elevada do fertilizante boratado, denominado ulexita, foram coletadas, em um vinhedo, amostras de folhas de ‘Itália’ com e sem sintomas visuais para análise química. Os resultados da análise química das folhas revelaram que havia teor mais elevado de boro nas folhas com sintomas visuais ( $424\text{mg}\cdot\text{kg}^{-1}$ ), do que naquelas sem sintomas ( $56\text{mg}\cdot\text{kg}^{-1}$ ), de plantas não fertilizadas com ulexita. Amostras de solo, a 0-25cm e 25-50cm de profundidade, de ambas as áreas, também foram coletadas. Nos vinhedos onde foi aplicada ulexita, os teores de boro no solo foram mais elevados ( $2,52\text{-}5,61\text{mg}\cdot\text{kg}^{-1}$ ) que nos vinhedos onde não foi aplicada ( $0,25\text{-}0,34\text{mg}\cdot\text{kg}^{-1}$ ). No ano seguinte, em abril, 60 dias após a poda, não foram mais verificados sintomas de toxicidade de boro nas folhas, devendo-se isso à lixiviação desse elemento para maiores profundidades do solo, visto

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tratar-se de terra arenosa e a cultura ser irrigada. Pode-se afirmar que a anomalia ocorrida nas folhas de videiras cultivar Itália, caracterizada por sintomas de clorose, crestamento e enrolamento do bordos, esteve associada à toxicidade de boro.

Palavras-chave: *Vitis*; nutrição; anomalia fisiológica; micronutriente.

## **Abstract**

In the Northwestern of São Paulo State, Brazil, in many vineyards of cv. Italia, an anomaly in leaves was verified characterized by limb yellowing followed by the appearance of many dark or brown patches and, upward rolling of old leaves that showed irregular and asymmetric margins. At the beginning of the studies these anomalies could be confounded with toxicity caused by pesticides. On the other hand, the symptoms were very similar to those associated to nutritional unbalance in vines, reported in many countries. With the objective of proving the hypothesis that those anomalies were related to nutritional unbalance due to application of high amounts of sodium and calcium borates fertilizer (“ulexita”), containing 8.6% of boron, leaves of ‘Italia’ vines, with and without symptoms, were sampled for chemical analysis. The results showed that leaves with symptoms had higher boron content (424mg.kg<sup>-1</sup>) than normal leaves (56mg.kg<sup>-1</sup>) from vines that were not fertilized with “ulexita”. Soil samples at 0-25cm and 25-50cm depths, from both areas, were also collected. At vineyards where “ulexita” was applied, the boron contents were higher (2.52-5.61mg.kg<sup>-1</sup>) than those with no fertilization (0.25-0.34mg.kg<sup>-1</sup>). In the following year, in April, 60 days after pruning, the vines did not show symptoms of boron toxicity due to lixiviation of this element, once these areas were irrigated and had sandy soils. It is possible to assume that the anomalies observed in vines cv. Italia, characterized by limb yellowing, necrosis and upward rolling of leaves were associated to boron toxicity.

Key words: *Vitis*; nutrition; physiologic anomaly; micronutrient.

## **Introduction**

The adequate boron level in vegetal organs of vines is very known. According to Fregoni (1980), the deficiency of boron is recognized when the leaf content is less than 25mg.kg<sup>-1</sup>, while Gärtel (1965)

reported that the limit is 14mg.kg<sup>-1</sup>. Fregoni e Scienza (1976) verified normal leaf content of boron in the range from 25 to 41mg.kg<sup>-1</sup>, while Fregoni (1980) reported optimum boron levels in the range from 15 to 38mg.kg<sup>-1</sup>. Terra (2003) reported that optimum boron levels are in

the range from 45 to 53mg.kg<sup>-1</sup>. Fregoni (1980) described toxic levels of boron higher than 150mg.Kg<sup>-1</sup> in leaves.

Many authors described symptoms of toxicity promoted by excessive application of borate fertilizers. Winkler et al. (1974) found that the specific symptoms start by the appearance of necrotic spots close to the leaves margins and the yellowing of the limbs. Later on, these spots coalesce and form a continuous necrotic patch from the margin to the center. Beyers (1962) reported that the excess of boron could lead to deformation of leaves with irregular margins. In many Italia vineyards located at northwestern of São Paulo State, Brazil, anomalies on leaves were verified, whose symptoms were yellowing, bronzing and rolling of the margins.

At the beginning of the studies these anomalies could be confounded with symptoms caused by inadequate application of pesticides. It was also formulated the hypothesis that these symptoms were related to nutritional toxicity, once they were very similar to those described in different cultivars of vines, in many countries.

This work was carried out with the objective of studying if the anomalies found in Italia grapevines were associated to nutritional toxicity due to application of sodium and calcium borates fertilizer denominated “ulexita”, containing 8.6% of boron, at 150g per vine.

### Material and methods

The experiment was carried out in a vineyard of Italia grapevine located at Palmeira D'Oeste, at northwestern of São

Paulo State, Brazil, at 20°16'S, 50°33'W and 483m altitude.

This vineyard was four years old, and the vines were grafted on the rootstock IAC 572 ‘Jales’.

In the middle of April 2004, several plants were sampled with the collection of leaves of young's shoots with and without symptoms, for chemicals analysis in the area fertilized with “ulexita”, at 150g per vine (12.90g per vine of B) and in the area not fertilized.

Soil samples for chemical analysis were also collected at 0-25cm and 0-50cm depths, two in the area fertilized with “ulexita” and two in the area not fertilized.

Leaves samples were processed and analyzed for N, P, K, Ca, Mg, S, B, Cu, Fe, Mn and Zn contents, while soil samples were processed and analyzed for P, K, Ca, Mg, B, Cu, Fe, Mn and Zn contents. Chemical analysis of leaves and soils were realized in the Soil Fertility and Plants Nutrition Laboratory of Instituto Agronômico, in Campinas (SP).

### Results and discussion

The visual symptoms observed on leaves were yellowing, followed by the incidence of dark or brown spots, that became numerous and, coalesced to form a continuous necrotic path from the margin to the petiole sinus. The leaves were necrotic and rolled upward, with irregular margins and petiole sinus opened (Figure 1).

The chemical analyses of leaves showed that the boron content in vines with symptoms was higher (424mg.kg<sup>-1</sup>) in the areas fertilized with “ulexita” at

150g per vine, than that in vines showing no symptoms and not fertilized with “ulexita” (56mg.kg<sup>-1</sup>).

As for the macro and micronutrients except boron, the results obtained did not permit to detect differences that could be related with the anomaly (Table 1).

These results are in agreement with Winkler et al. (1974) that verified boron content higher than 200mg.kg<sup>-1</sup>, in leaves with characteristic symptoms of boron toxicity; and with Fregoni (1980) who reported boron intoxication in leaves with higher than 150mg.kg<sup>-1</sup> boron content.

The chemical analyses of soil showed that boron contents in the areas fertilized with “ulexita” at 150g per vine, were higher (2.52 and 5.61mg.dm<sup>-3</sup>, at 0-25 and 25-50cm depths, respectively) than those in the areas not fertilized (0.25

and 0.34mg.dm<sup>-3</sup>, at 0-25 and 25-50cm depth, respectively) (Table 2).

Kuniyuki et al. (1985) verified in October – November 1980, an anomaly in the grapevine Niagara Rosada, characterized by leaves yellowing, dark brown pulp and malformed clusters, in vineyards of Indaiatuba and Jundiá (SP), Brazil. During 1981 and 1982, experiments were carried out in the vineyard of eighty year old grapevine Niagara Rosada, located in Indaiatuba (SP), which plants had presented those symptoms in 1980. The experiments consisted of application in the soil, after winter pruning, in August, of sodium borates fertilizer (borax), containing 11% of boron, at the rates of the 5, 10 and 20g per vine. The authors concluded that applications of 10 to 20g per vine of borax

**Table 1.** Mineral content of leaves of ‘Italia’ grapevines, with and without anomalies. Palmeira D’Oeste, SP. 2004.

Anomalies	Mineral Content										
	g kg <sup>-1</sup>					mg kg <sup>-1</sup>					
	N	P	K	Ca	Mg	S	Fe	Mn	Cu	B	Zn
No symptoms	32.2	3.5	15.8	13.2	4.9	3.2	119	1005	30	56	157
Symptoms	33.2	3.8	17.1	12.9	4.9	3.6	131	1070	39	424	165

**Table 2.** Mineral content of soils in ‘Italia’ vineyards, with and without anomalies. Palmeira D’Oeste, SP. 2004.

Anomalies	Depth (cm)	Mineral Content								
		mg dm <sup>-3</sup>	mmolc dm <sup>-3</sup>			mg dm <sup>-3</sup>				
		P	K	Ca	Mg	B	Cu	Fe	Mn	Zn
No Symptoms	0-25	203	6.2	43	13	0.25	1.7	27	14.4	4.0
	25-50	244	5.2	50	6	0.34	1.3	38	10.5	2.5
Symptoms	0-25	215	6.8	44	10	2.52	1.8	25	13.2	3.8
	25-50	252	5.4	53	5	5.61	1.5	35	10.0	2.2

in the soil (1.10 to 2.20g per vine of boron), in vineyards with vines that presented those symptoms promoted the control of the anomaly. They also concluded that this anomaly was associated to a boron nutritional deficiency, and that could be effectively controlled with applications in the soil of boron fertilizer, in those recommended dosis.

In the vines that presented those visual symptoms, 12.90g per vine of boron were applied in the soil, which is a dosis as high as 5 to 12 times than that

boron content in the soil is lower than  $0.21\text{mg}\cdot\text{dm}^{-3}$ , in vineyards cultivate with Italia grapevines grafted on the rootstock IAC 572 'Jales' in the northwestern of São Paulo State. By the way, Table 2 shows that the contents of boron in the soil, in the areas where the "ulexita" fertilizer was applied, presented values 10 times higher (2.52 to  $5.61\text{mg}\cdot\text{dm}^{-3}$  of boron) than those recommended by the mentioned authors. Nevertheless, the vines that presented those visual symptoms were fertilized with 12.90g

**Figure 1.** Symptoms of boron toxicity in young shoots of 'Italia' grapevine



recommended by Kuniyuki et al. (1985) for the grapevine Niagara Rosada (1.10 to 2.20g per vine of boron).

Terra et al. (1998) recommend an application in the soil, a maximum of 2.25g per vine of boron (26g per vine of "ulexita") after pruning, when the

per vine of boron in the soil, an amount 5 times higher than that recommended by the same authors.

These considerations highlight the fact that the anomalies present in some vineyards were associated to boron toxicity.

In the following year, in April, 60 days after pruning, symptoms of boron toxicity were not verified in leaves anymore, probably due to the lixiviation of this element, once these areas were irrigated and had sandy soils.

### **Conclusion**

It is possible to assume that the anomalies observed in 'Italia' grapevines, characterized by yellowing, necrosis, deformation and rolling of leaves were associated to toxicity of boron.

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