CONSIDERATIONS ON SOME POLYTUNNELS SOIL CHARACTERISTICS THAT FAVOR THE NON-PARASITIC DISORDER BLOSSOM-END ROT ON TOMATOES

Camil Ștefan LUNGU CONSTANTINEANU[1], Feodor FILIPOV[2]

e-mail:camilul@yahoo.com

Abstract

Blossom-End Rot is a non-parasitic physiological disorder found in tomatoes, peppers, eggplants, and some melons. It occurs due to a low level of calcium in soil and high fluctuation of available water .Thus, a calcium deficiency occurs during fruit maturation, which lead to lesions. The affected area can cover up to half fruit. This disorder can also occur when there is an excess of calcium in the soil. Most of the water is lost by evapotranspiration and the calcium accumulates into the leaves. Fruits do not transpirate as much as leaves, so less calcium is stored in the fruit, resulting in a calcium deficiency in fruit. Another favorable factor is over-fertilization with some nutrients. One of the objectives of the paper is the soils characterization on which have been identified plants affected by Blossom-End Rot. It were studied greenhouses and polytunnels soils from several locations (Barlad, Spataresti-Falticeni, Bacau) in North-Eastern Romania. Following the investigations, it was found that the symptoms on tomatoes were not due to a parasite action. In the areas where Blossom-End Rot was identified, soil profiles were developed and analyzed. In the laboratory were determined some properties of soil samples taken. The analytical data obtained in the laboratory reveals that this disorder occurs on soils with a coarse texture, sand and loamy sand soils, moderate acidic, with a very low acidification buffering capacity, located in the marginal areas of the polytunnels. The correct identification and differentiation of Blossom-End Rot from gray rot caused by the pathogen *Botrytis cinerea*, presents a particular practical importance in order to establish prevention measures and cultural recommendations.

Key words: *Blossom-end rot*, tomatoes, polytunnels, soil

Blossom-end rot is a serious physiological disorder caused by a calcium deficiency that occurs during the period when the tomato fruits are enlarging.

The name of this disorder is very intuitive, because it appears like a large, gray to black rot, localized at the apical end of the tomato fruit, opposite the stem. It affects green as well as ripe fruits.

This disorder is a common, non-parasitic physiological condition found on tomatoes, peppers, eggplants, and some melons. It is a symptom of calcium deficiency in fruit. This can be caused by a low calcium level in soil, low calcium level during fruit maturation, or other cultural factors, especially the fluctuation of soil moisture. This disorder is usually more severe in extreme soil moisture conditions, too dry or too wet (McLaurin, 2003). These conditions lead to a calcium deficiency, that occurs during fruit maturation and the appearance of a lesion in that place. The disorder is more prevalent on tomatoes; however, it may also occur on other cultures, and the symptoms on the fruit are the same (Taylor & Locascio, 2004). Another symptoms of a calcium deficiency are curled and distorted leaves, which often show a hook at the leaf tip and stunted growth.

However, the causes of this disorder are not fully elucidated. Some theories show that the appearence of this affection is not directly related to the dysfunctions caused by calcium deficiency (Nonami *et al*, 1995) or would be a link between calcium deficiency and some cellular changes in the fruit (Ho and White, 2005).

As we mentioned before, Blossom End Rot appears due to a low level of calcium in fruit, but this deficiency may be linked to a calcium excess in other organs. Dissolved in water, calcium is absorbed and circulates through the plant via the vascular system, from roots to leaves. Under high humidity conditions, water containing calcium and other minerals, reaches the leaves quickly. Most of the water is lost by leaves transpiration, and most of the calcium is found in the leaves after the transpiration is over. Fruits do not transpirate asmuch as leaves, so less calcium is stored into the fruit, resulting a calcium deficiency in fruit. Ninety

[1] Institute of Biological Research, Iași
[2] "Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine, Iași

percent of the calcium contained in the mature fruit is already there when the waxy suberine layer is formed, when the fruit is still small (McLaurin, 2003).

From a practical point of view, it is important to note that calcium deficiency in fruit is rarely due to the calcium content of the soil (Borlan *et al*, 1992). Usually, this physiological disorder is induced by other soil properties or by extreme climatic conditions.

One of the attributes of the soil that favors this disorder, is also the reaction medium characterized by pH values lower than 5 (6.5) or higher than 8.

High content of some nutrients such as N, K, Mg, Na, Mn, antagonists to Ca, can induce Blossom end rot. The excess of these elements leads to insufficient absorbtion of calcium (Pripa, 2018).

Climatic factors like low temperature of air and soil, high humidity or low temperature difference between day and night, can also favor Blossom end rot (Pripa, 2018).

Root damage caused by nematodes and agricultural maintenance, on mineral soils with fine texture, can determine worsening of calcium nutrition on vegetables in greenhouses and polytunnels (Borlan, 1994)

The most important effect of this disorder, is that the fruits reach maturity prematurely and become inedible, losses on tomatoes can reach 50% (Taylor & Locascio, 2004). We mention that the bacterial attack of *Pseudomonas syringae pv tomato* may appear, which uses *Blossom end rot* as an entry gate (Pripa, 2018).

It is important to mention that *Blossom End Rot* can often be misidentified as gray rot caused by pathogen *Botrytis cinerea* Pers., which is a fungus (*Ascomycota*). Both disorders manifests by brown spots on fruit skin surface, both are favored by high humidity and weak airing in polytunnels. The differences are that *Blossom End Rot* lesion is always at the end of fruit, but gray rot lesion occurs at the opposite part, next to stem, this why fruit easily detached. The highest differentiation can be made by examining the spot on the fruit, the lesion produced by the gray rot being covered by a thin layer of whitish puff, representing the spores of the *Botrytis cinerea* fungus. In the laboratory, the correct identification of spores can be made. Also, the difference between the two disorders lies in the fact that Blossom End Rot occures from the inside outwards, and the gray rot pathogen occurs from the outside to the inside, requiring an entry gate.

MATERIAL AND METHODS

It were studied greenhouses and polytunnels soils from several locations (Barlad, Spataresti-Falticeni, Bacau) in North-Eastern Romania.

Observations were made on tomato fruits (*Lycopersicon esculentum* Mill.) in three farms.

Field observations has been made on plants that showed some symptoms of growing stagnation due to diseases and nutrient deficiencies. It were prelevated field samples of biological material, the samples being analyzed in the laboratory, using the Olympus stereomicroscope, or a magnifier.

In some situations, the tomato fruit plants affected by blossom end rot were located in areas where the moderate or strong compaction of the sub-arable layer was evident. Extending the width of the wet band on the soil surface, by drip irrigation, is due to the compact sub-arable layer that prevents or slows the infiltration of water.

After the ending of vegetation cycle, soil profiles were developed, described and characterized.

Characterization of soil formation factors and profiles was done following the instructions from guidelines for soil and land descriptions (Florea *et al*, 1987).

Undisturbed and disturbed samples were collected, from each 10 cm soil horizon to the depth of 100 cm in order for laboratory analysis such as particle size, bulk density (Florea *et al,* 1987, Dumitru *et al*, 2009).

As a result of the investigations, it was found that the symptoms on tomato fruit were not due to the action of a parasite or a disease.

RESULTS AND DISCUSSIONS

Based on studies upon the causes that determines the physiological disorder Blossom End Rot, it was established that is due to calcium deficiency. The symptoms of Blossom End Rot on tomatoes also occur in situations where the soil is well supplied with calcium. The groups of factors that cause Blossom End Rot are shown in the scheme in Figure 1.

Interestingly, Blossom End Rot has been highlighted both on soils with high permeability (eg. sandy and loamy-sand soils) and on low permeability soils (soils with fine texture or strong compacted horizons). In the case of soils with high permeability, calcium ions are removed from the infiltration waters and on clayey and compact soils the root system of plants is less developed, explores less soil volume and can not absorb sufficient amounts of calcium, especially in the stage of intense fruit growth.

The low content of humus, high acidity (ph<5), low buffer capacity, and high content of soluble salts are other factors that worsen calcium plant nutrition.

Root tips damages of tomato plants, following nematode attack or due to the high depth of the hoeing, reduces the ability of the roots to absorb calcium ions and amplify calcium deficiency in tomato fruit.

Blossom End Rot symptoms occur in the case of low calcium content in the soil, but are frequently induced by the excess of nitrogen, manganese, potassium and copper in the soil.

Of the climatic factors limiting the absorption of calcium by the plant root system, we mention low air humidity, high temperatures, prolonged droughts that amplify fluctuations in soil water content and increase water stress on plants.

The analytical data obtained in the laboratory reveals that this disorder occurs on soils with coarse texture, sand and loamy sand soil, moderately acidic, with a very low acidification buffering capacity, moderately or strongly compacted soils, located in the marginal areas of the greenhouses (Lungu-Constantineanu *et al*, 2018).

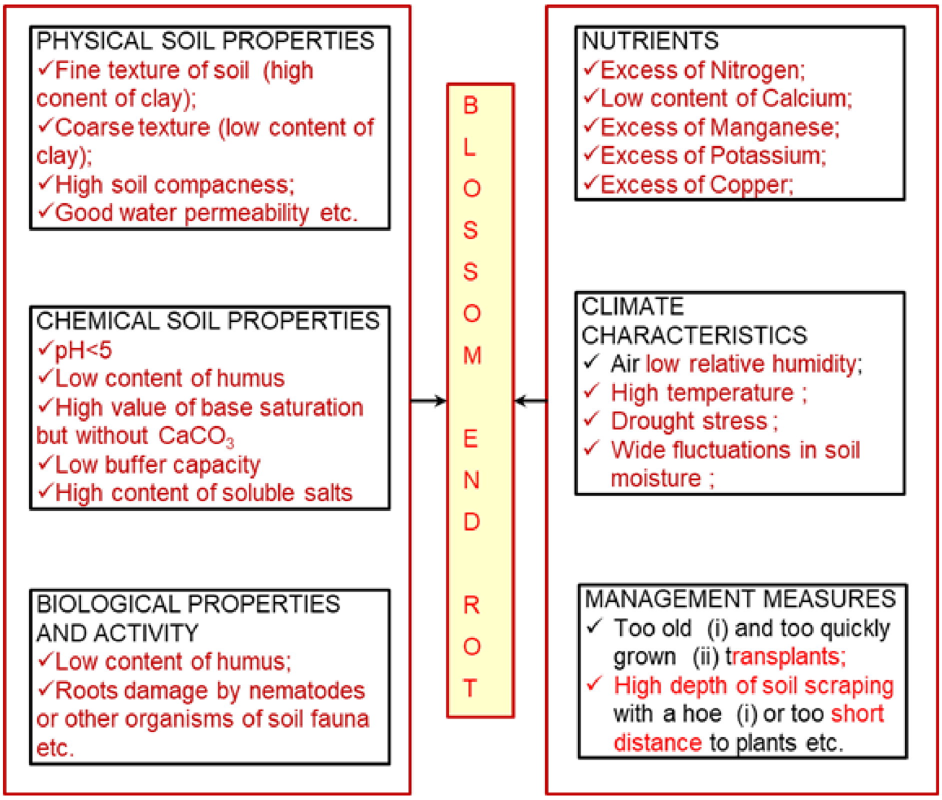

Figure 1 **Diagram showing the symptoms of calcium deficiency in the tomato plants (Original)**

Frequently, the incidence of physiological disorder *Blossom End Rot* manifest on the apical part of tomato fruits grown in the soil with high compactness state of soil horizon. The presence of plowpan or tillpan induce a deficitary hydric regime and diminished ions Calcium uptake by root system.

In Bârlad greenhouses was reported a physiological non-parasitic disorder called *Blossom-End Rot* (*figure 1*), less known in Romania. Generally, it is found on tomatoes, peppers, eggplants and some melons. It is a symptom of calcium deficiency in fruit, caused by low levels of calcium in soil, especially because of the fluctuation of soil moisture (too wet or too dry).

The damaged tomato fruits by Blossom End Rot was found in greenhouses from Barlad and Spataresti (*figure 2*). The soil was diagnosticated as hipohortic Fluvisols (figure 3). We consider that the presence of strong compacted soil horizon on the depths of 27 (30) -39 (43) cm, with high bulk density value (1.63g/cm3) is the main factor of incidence of Blossom End Rot (*table 1*).

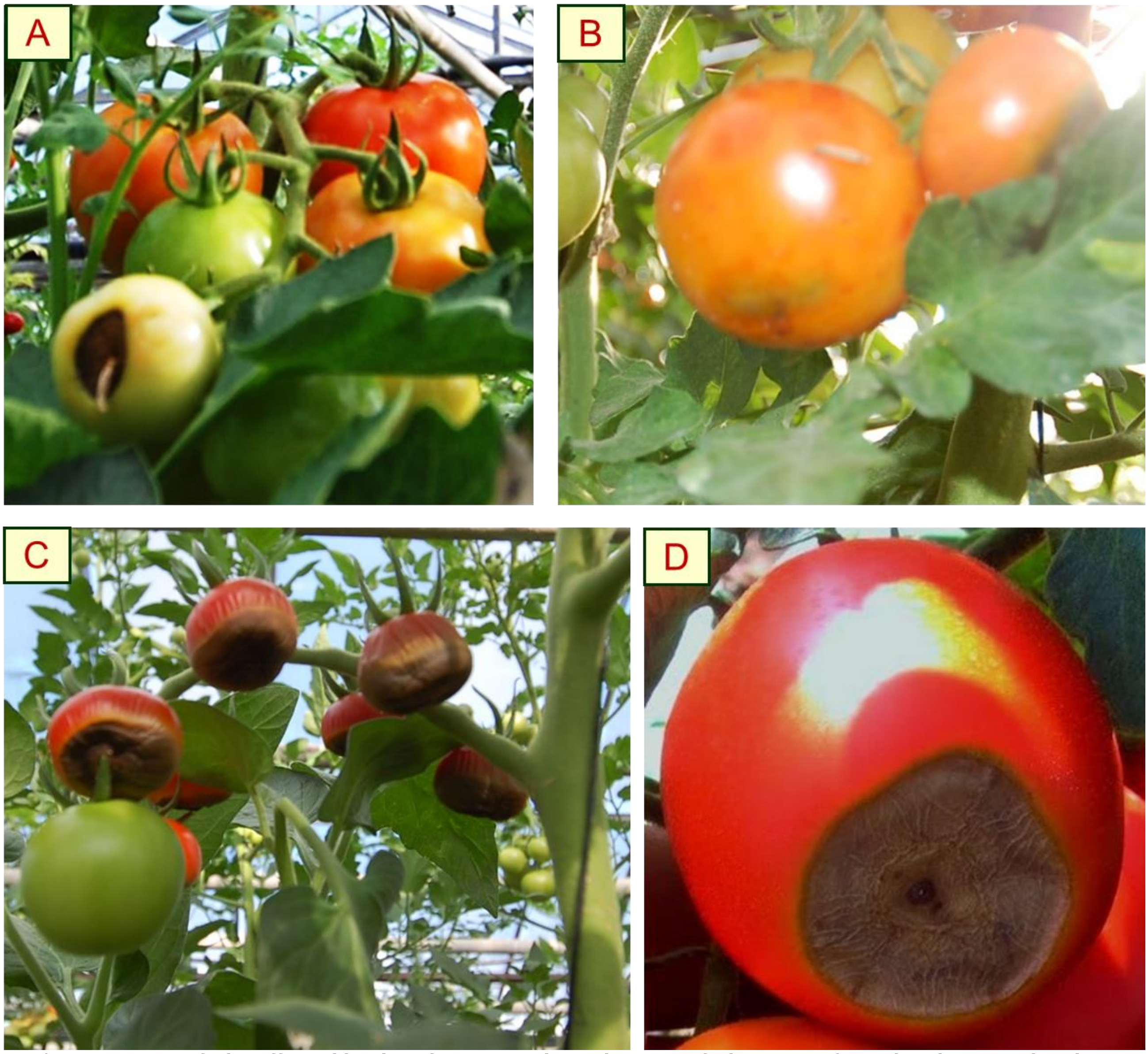

Figure 2 **Tomato fruits affected by the *Blossom End Rot* (A- green fruits; B – Before Ripening; C –Ripening fruits; D-Detail) Original Photo**

Table 1

Bulk density, pH values and texture of hipohortic Fluvisols from Barlad greenhouses

Depth (cm)	Thickness (cm)	Pedological horizon	BD g/cm^3	Texture	pH
0-11	11	Ap_1*	1.05	Loamy-sand	5.5
11-27 (30)	16(19)	Ap_2	1.26	Loamy-sand	5.4
27 (30)-39-43	11 (14)	Atp	1.63	Loamy-sand	6.5
39-48	9	Am	1.67	Loamy-sand	6.1
48-59	11	Bv_1	1.43	Loamy-sand	5.8
59-80	21	Bv_2	1.47	Loamy-sand	5.7

Hipohortic fluvisols is strong compacted in the CA horizon. In the AC horizon compaction is not continue due to performing deep soil loosening works.

After these works the sandy soil was loose only locally, near the active parts of the soil loosening. The loose soil in the AC horizon is bounded by the broken white line.

We mention that distance between the distance between the loose soil strips within the cross section of the soil profile is about 80 cm.

We consider tnhat the distancebetween loose soil strips is too large and the compact soil layer restrictions were only partly diminished.

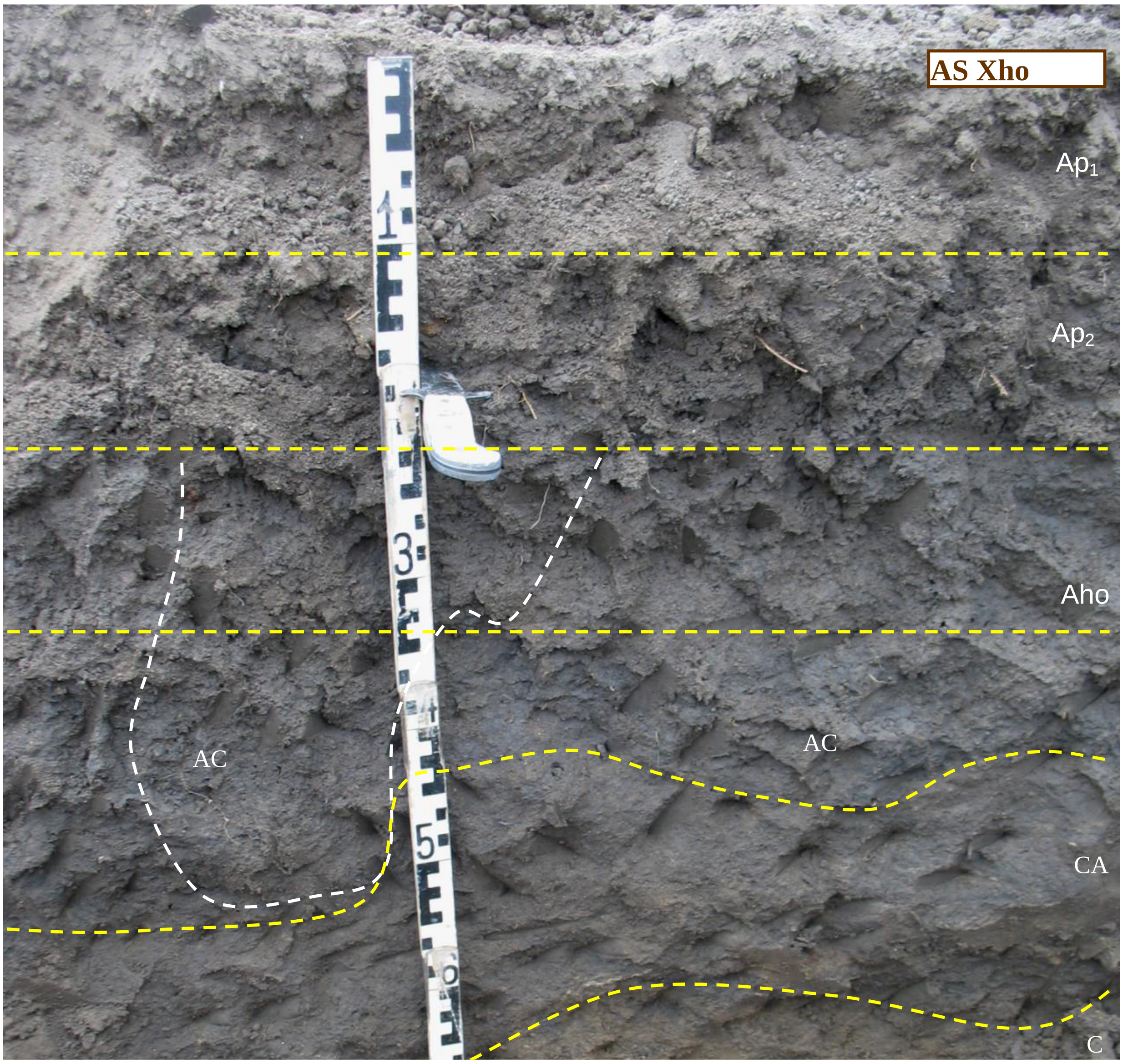

Figure 3 **Hipohortic Fluvisols from Barlad greenhouses**

CONCLUSIONS

Blossom End Rot poate fi adesea confundată cu gray rot caused by pathogen Botrytis cinerea Pers., which is a fungus (Ascomycota).

Both diseases are manifested by brown spots on the fruit surface, both of which are favored by increased humidity and poor ventilation of the greenhouses. The difference is that in the case of Blossom End Rot, the lesion always appears in the apical part of the fruit, and in the case of gray rot, the lesion occurs predominantly in the flourish of the fruit, which is why the fruit easily detaches itself.

Blossom End Rot appears only on the fruit, while gray rot appears on the leaves and on the strain.

The clearest differentiation can be made by examining the spot on the fruit, the lesion produced by the gray rot being covered by a thin layer of whitish puff, representing the spores of the Botrytis cinerea fungus. In the laboratory, the spores can be correctly identified.

Also, the difference between the two conditions lies in the fact that the Blossom End Rot appears from the inside outwards, and the gray rot appears from the outside to the inside, requiring a pathogen entry gate.

The analytical data obtained in the laboratory reveals that this condition occurs on coarse texture soils, sand and loamy sand soils, moderately acidic, with a very low acidification buffering capacity, moderately or strongly compacted soils, located in the marginal areas of greenhouses.

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