COMERCIAL DISORDERS OF TOMATO FRUITS – POSSIBLE CAUSES AND CONTROL
I. DISORDERS DEPENDING OF CLIMATE, GENETIC AND TECHNOLOGICAL FACTORS

DEFECTE COMERCIALE ALE FRUCTELOR DE TOMATE – CAUZE POSIBILE ŞI REMEDII
I. DEFECTE CAUZATE DE FACTORI CLIMATICI, GENETICI ŞI TEHNOLOGICI

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Abstract. *The main commercial disorders related to ripening, color, shape or firmness of tomato fruits have been presented. The selected disorders are the most common ones, present either in open field or indoors and might cause important losses of yield. Uneven or blotchy ripening, blossom end rot, misshaped fruits, internal browning or whitening "vessels", cracking fruits. These symptoms are analyzed from the perspective of climatic reasons (too high temperature, atmospheric drought, high solar radiation), technological ones (inappropriate irrigation and/or fertilization, use of some plant growth regulators) or genetic ones. Prevention and treatment methods have also been described.*

Key words: tomato fruits, commercial disorders, climatic, management, genetic reasons, prevention, control

Rezumat. *În lucrare sunt prezentate principalele defecte de maturare, de culoare, de formă şi de consistenţă ale fructelor de tomate, întâlnite mai des în culturile din România din câmp şi din spaţii protejate şi care reduc uneori sensibil producţia comercializabilă. Printre acestea sunt descrise fructele cu maturare neuniformă, cu ţesut alb în pereţii loculari, cu putregai apical, fructele deformate, cu goluri, crăpate, sau pătate. Aceste simtome sunt analizate prin prisma unor cauze posibile cum ar fi cele de natură climatică (temperaturile ridicate, seceta atmosferică, insolaţia), de natură tehnologică (irigarea şi fertilizarea necorespunzătoare, aplicarea unor regulatori de creştere), genetică şi altele. Cazurile menţionate sunt însoţite de măsuri de prevenire şi remediere.*

Cuvinte cheie: fructe tomate, defecte comerciale, cauze climatice, tehnologice, genetice, prevenire, remediere

INTRODUCTION

Quality of agricultural products in general and vegetables in particular is a complex concept which includes a large number of characteristics and can be

appreciated basis on more criteria: the species and the plant part taken into account, the destination of the crop, size, firmness and shape of the fruits, color, taste, symptoms of diseases, nutritive and energetic value, and many other relevant signs and symptoms in this meaning (Lacatus and colab; 2006; Bissuel Christine 1999). The quality of vegetables in a modern acception includes a perfect appearance, high use value and on the other hand a high level of beneficient constituents, silmultaneously with an as low as possible content of dangerous substances (Petitjean Marie-Francoise 2001; Lacatus 1999;Hardh 1982). The changing of some climatic factors, both at the global and at the regional level, in the night and day, low relative humidity, the drought but the cold rains or the hail too, have directly or undirectly affected the plant metabolism and implicitly the ripening way of the tomato fruits (Lacatus and colab 2009; Lacatus 2007; Lacatus and Voican 2006). It is equaly true that some technological factors such as irrigation, fertilization, and the stimulation or the environmental factors directing in the case of the protected crops have largely affected the commercial and nutritional quality of tomato fruits (Voican, Lacatus 2006; Lacatus et colab. 2006; Lacatus and colab 2009; Lacatus, Tutuianu 1998; Blancard 1994; Hobson and colab. 1977).

In this paper are presented the observations, which habe been carried out by our staff, both in experimental and in commercial tomato crops, either in the open field or in the greenhouse spaces. To these we add the findings of other experts in this field of activity. (Blancard, Lecocq, Laterrot, Hobson and athers). The purpose of the paper is to spread our observations among the specialists but also among the farmers, to lighten them the diagnosis, and especially to contribute as far as possible to the prevention of some symptoms which usually depreciate the commercial and nutritional quality of tomato fruit. And last but not least, to update some of the prevention and control measures in the field of mineral nutrition and nutritive solutions.

MATERIAL AND METHOD

The effort has materialized in the description of five cases in which the commercial quality of tomato fruits was strongly affected. The considered factors through which the tomato crop was kept under observation were the following: **a)** factors of climatic nature (high or low temperatures, great temperature differences between night and day, low or high relative humidity, sunstroke, hail); **b)** factors of technological nature (the cultivation of some inadapted hybrids discontinuous, insufficient or excessive irrigation, inadequate ventilation and planting densities, excessive defoliations); **c)** factors of agrochemical nature (deficiency of potassium and calcium in the soil, excess soluble salts in the soil solution); **d)** factors of genetics nature. In order to simplify the work, we will synthetically expose the cases using as main procedures the description, the explanation of all causes and as a result of our observations the proposal of various and suitable remedies.

RESULTS AND DISCUSSIONS

1. Blotchy ripening (fig.1.). This ripening deficiency is one of the most commonly found in tomato crops grown not only under protection, but also in the open field. A part of the fruit delays its maturation proces, forming a green, yellow or

virtual uncolored area. In the section, in the pericarp, a browned tissue may occur, without being about a virus or bacteria (fig. 1a). Sometimes there is a waxy patch, an extreme form of blotchy ripening, where the walls of the fruit have a translucent appearance (fig. 1d). On the fruit surface it does not notice hollows and drops or simple irregularities, but the discoloured areas are stronger than surrounding tissues which normally at the red colouring are somewhat softer. Most often, the area, which is showing an abnormal pigmentation, lies around the calyx zone. The route of the vascular fascicles as a result of the purplish- brown tissue, can be often pursued in the pericarp of the fruit, especially when the normal pigments are in small enough quantities.

a) **b)** **c)** **d)**

Fig.1. Fruit discoloration in the maturation proces

The fruits with an affected area of 40 % and with browned vessels 100 % had a nitrate content lower with 69 %, the acidity lower with 21 %, potassium lower with a rate of 14 % dry mass content lower with a rate of 13% and the total sugar content lower with a percentage of 6 %.

Causes. Lack of potassium, stress due to environmental factors that affect the supply routes of the plants in the most sensitive point – the cells with thin walls which form the vascular channels. Among the environmental factors we mention the temperature, whose influence on the synthesis of pigments is well known. Thus, low temperatures tend to reduce the synthesis of lycopene, but temperatures above 30°C may also inhibit the production of lycopene. This latter case is very common in the most green and plastic houses in Romania, whose ventilation system and surface are uncorrelated with the temperatures of the months of the period June- August. Likewise, temperatures of 40°C or higher inhibit carotenoid synthesis. At these temperatures the production of ethylene and the synthesis of polygalacturonasis. are also inhibited An indirect cause of the fruits temperature increase may be the exaggerated plant defoliation.

Remedies. Avoid high temperatures and the excessive defoliations, shading, the increasing of the potassium dose with about 25 %, growing the hybrids with mid-size fruits and the tolerant hybrids. Tolerance to high temperatures (as also to the low temperature) differs from hybrid to hybrid, depending of the temperature value and exposure time. In the case of tolerant hybrids, the negative effects of high temperatures may still be reversible after 2 days of exposure at 40°C, 4 days at 35°C or 6 days at 30°C if the fruits are transferred to a warehouse with an optimum temperature for maturation proces (20-25°C).

2. Fruits with green or greenish yellow collar-greenback (fig. 2.). The fruit does not ripen evenly, not redden entirely, leaving around stalks an yellow or

green zone. The phenomenon is sometimes encountered in hybrids with large fruits that are not perfectly spherical, have some so-called "shoulders" which remain hard green while the remainder of the fruit ripens normally. These are hybrids likely able to accumulate a higher content of chlorophyll in the walls of the unripe fruit. The phenomenon is specific for the hybrids with darker foliage and which respond in this way to a stronger nitrogen fertilization. Area appears as a circle (completely or partially) around the calyx and remains so, or transferred to green-yellow or even to yellow covering till one third of the total fruit surface. Inside, under these areas may occur a white tissue containing starch, strongly brow ned cell walls and empty spaces between cells.

Causes. Susceptibility of some hybrids to gain a higher content of chlorophyll in the walls of the unripe fruit; a real cause can also be the excessive solar radiation and hot air streams.

Remedie. Increasing doses of phosphorus and potassium; shading; avoiding drastic defoliation; cultivation of hybrids with genetic resistance.

3. Fruits affected by sunscald. Sunscald occurs in maturation green stage through an yellow or whitened areas, diffuse spot, which appears on the solar radiation exposed side. On the green fruits, this area is dehydrated and the epidermis becomes like a "skin" or wiggles.

Fig. 2. Greenback

Fig.3. Sunscald

Causes. Strong exposure to sunlight with fruit temperatures larger than 30°C which inhibits the synthesis of lycopene, but not that of carotene.

Remedies. Shading and avoid excessive defoliation.

4. Fruits with white tissue in the locule walls. Apparently, the fruits are normally colored and the epidermis is of an uniform red. But when the fruits are cut, inside in the locule walls occurs a white tissue that can all around or only partly include the fruit, usually in the peduncle zone. Affected cells are hard, thick and opaque.

Causes. Mostly, this ripening deficiency is caused by the cultivation of hybrids which are inappropriate for the environmental conditions, especially in protected culture, when some cultivars carryng the „even ripening” allele are exposed to excessive sunlight. It is mainly about hybrids or varieties with ovoid fruits , often for growing in the open field for processing. The phenomenon has increased in recent years due to excessive solar radiation and insufficient potassium fertilization.

As we have already indicated in the case of the spotting ripening, the environmental factors stress causes interruption of the leading fascicles in their

most sensitive points, namely the cells of thin walls joined to the vascular fascicles, forming in this way a brown tissue, sometimes in the locular walls. The more thickened and lignified the cells are, the more white tissue is formed as a result of the stress and premature aging.

Fig. 4. Fruits with „white" tissue within the thickness of the locule walls

Remedies. Selection of hybrids suitable for the conditions from Romania, increasing the dose of potassium with a rate of 25% and reducing excessive exposure to sunlight using the shading method.

5. Affected fruits by blossom-end rot (fig. 5). In the apical part of the fruit develops a circular area of brown colour, relatively hard and dry. When plants are grown on unamended acidic soils, or acid peat substrate, or on salty soil, specific symptoms occur on the leaves. The leaflets of the top leaves are dark green firstly with pale green edges and then they become yellow, curl and dry up. Growing tips die. Symptoms spread to the base leaves.

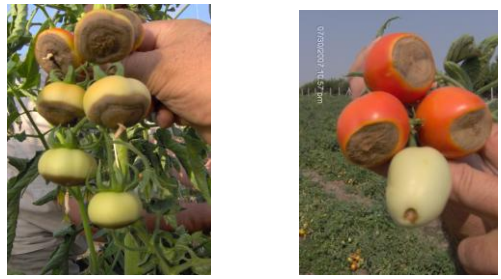

Fig. 5. Fruits affected by blossom-end rot

Causes. The main issue is the lack of calcium. This may be directly due to lack of calcium in the soil. But there may be a sum of factors that induce this failure. Calcium, like other nutritive elements, is transported into the plant by means of water. When there are factors hindering continuous water supply, is interrupted the plant calcium supply too, which unlike other nutritive elements are not translocated from older to younger leaves towards growing tips. It remains fixed in the cell walls in the shape of calcium pectin. The lack of water due to either discontinuous irigation or soil pathogen agents, which cause vascular disease or to excessive concentrations of soluble salts (as a result of fertilization with high doses, especially with ammonium nitrogen-based fertilizers) induces calcium deficiency. This phenomenom can happen when tomatoes are cultivated on the cold soils, because of the developing of a poor root system, which can not sustain a normal water supply of the air part under the conditions

of a strong evapotranspiration. Also, the unbalanced fertilizations outline the antagonism of the ammonium, magnesium and potassium ions with the calcium ion. The phenomenon is commonly encountered in the open field tomato crop in early periods, but later in autumn, when the green fruits are affected, making impossible to market them as green pickled tomatoes. Also it is encountered in the cultures from protected areas, at the plants affected by *Verticillium dahliae***,** as in the case of an inadequate ventilation in the conditions of a very high relative air humidity. And the water excess in its turn can cause calcium deficiency due to the asphyxiation root system. Sometimes, calcium deficiency can be found in the case of the cultivation of some hybrids sensitive to lack of calcium.

Remedies. Amendment with calcium carbonate of the acid soils, or peat in the case of the crops on this substrate; the suitable addition of calcium nitrate in nutrient solutions; uniform and continuous irrigation; achievement of an optimal ventilation; treatment of diseased plants, at the root and leaves with a solution of Topsin M 45 0.1 to 0.15 %; preventive foliar fertilization with CaFORTE 0.3 to 0.5 %.

CONCLUSIONS

1.The excessive climate factors, some technological measures, but the lack of potassium and calcium, significantly reduce the percentage of marketable tomato fruits;

2.The cultivation of some inadequate tomato hybrids and varieties, some of them being genetically sensitive may also affect the commercial quality of the fruits.

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