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ТАБИГЫЙ ИЛИМДЕР СЕРИЯСЫ
ГУМАНИТАРДЫК ИЛИМДЕР СЕРИЯСЫ

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Effects of Root Zone Temperature on Blossom-end Rot of Sweet Pepper (Capsicum annuum L.) Fruits

Верхушечно-плодовая гниль может значительно больше развиваться у сладкого перца [illegible] теплице в регионах с умеренным климатом в течение лета. Температура играет ключевую роль в [illegible] ВПГ плодов. Основная задача этого исследования: изучить влияние температуры корневой [illegible] появление ВПГ у сладкого перца. В основном начальное проявление ВПГ резко повышается (до [illegible] почвенном культуре в конце мая. Максимальное проявление ВПГ плодов у беспочвенной культуры [illegible] начале июня и охватывает до 36,3% от общей площади поверхности спелого плода. По результатам [illegible] исследований можно сделать вывод, что при повышении температуры (16-28° С) в средней [illegible] системы на 1°С, проявления ВПГ плода увеличивается на 4% у беспочвенной культуры и на 1,5% [illegible] культуры.

Blossom-end rot (BER) may reduce significantly sweet pepper production under greenhouse in Temperate [illegible] summer season. Temperature might play a key role to generate BER fruits. The objective of the present study was to [illegible] of root zone temperature on the incidence of BER in sweet pepper fruits grown in soil and soilless culture. Initially [illegible] BER fruits increased abruptly to the highest incidence (12.5%) of BER fruits in soil at the end of May. Sweet pepper [illegible] in rockwool slabs reached the maximum incidence of BER fruits at the beginning of June, with 36.3% of marketable [illegible] soil with soilless culture, relationships between temperature of root zone media and the incidence of BER fruits, there [illegible] differences (r^2=0.88, 0.57 respectively). It can be concluded from the coefficient of linear regression function [illegible] temperature (range between 16-28 °C) of root zone media with 1°C, increased the incidence of BER fruits with [illegible] soilless and soil grown sweet pepper respectively.

Introduction

Sweet pepper grown under protected cultivation (glasshouse and plastic-house) in soil or [illegible] substrates (on rockwool) is a valuable crop worldwide. In the Temperate region, sweet pepper [illegible] *annuum* L.) is also one of the main crops for greenhouse cultivation and high-quality yield [illegible] prerequisite for its economical success. Sweet pepper growing under plastic covered greenhouses [illegible] food crop in Hungary also. It is widely held that so-called 'Ca-related' disorders, such as blossom-[illegible] tomato and sweet pepper fruit and tip burn in leaves of vegetables. Blossom-end rot (BER) [illegible] significantly sweet pepper production mainly during summer season. BER causes high economic [illegible] pepper production, as affected fruits have little value. The economic loss caused by BER was [illegible] the range of 20-40% of the total yield in Europe (Silber et al., 2005).

Small brown necrotic areas of pericarp tissue of distal end of the fruit appear first, [illegible] local calcium deficiency (Morley et al., 1993). Although it is widely accepted that local calcium [illegible] efficient cause of BER (Ho et al., 1995), but there are also some claims that it is not (Nonami, [illegible]

Numerous researchers conducted that blossom end rot arises from unsupplied of increased calcium demand of young sweet pepper fruit (Ho et al., 1995; Marcelis and Ho, 1999). In spite of this, Murray et al., (1972) found no differences between Ca concentration in normal and BER fruit.

Robbins (1937) observed that the initial symptoms of BER appeared most often shortly after a sudden change of cool, dark weather with low evaporation rates. Ho et al., (1993) suggested that more sunshine and higher temperatures were required to induce BER after a period of predominantly sunny weather than after a less sunny period.

Plastic covered greenhouse cooling is difficult in summer, and several different methods are usable to decrease maximum temperature, for example white washing, fogging and forced ventilation (Gázquez et al., 2006).

Calcium uptake is determined by root function and transpiration rate, and factors that stimulate water uptake increase Ca uptake in tomato. Ca uptake increased with water uptake as the root temperature was increased from 14 to 26°C or as the vapour pressure deficit increased from 0.1 to 0.8 kPa (Adams and Ho, 1993).

The objective of the present study was to examine the effects of root zone temperature on the incidence of BER in sweet pepper fruits grown in soil and soilless (rockwool) culture.

Materials and Methods

Sweet pepper cultivar 'Emese' F1 (indeterminate growth, upright of elongated conic shape, white, fruit weight 90-120 g; (http://www.duna-r.hu/index.php?id=163), was grown in plastic covered greenhouses, to investigate effect of root zone medium temperature on incidence of blossom end rot.

There were two different treatments, plants grown in soil and on rockwool (Grodan type). The result of the sandy clay soil analysis was the following: pH 7.6, salinity <0.02 m/m%, CaCO3 content 1.0 m/m%, humus content 2.9% m/m%, NO_3-NO_2-N 10 mg/kg, P_2O_5 300 mg/kg, K_2O 550 mg/kg.

Seeds were sown for soil culture on 20th of December and for rockwool culture on 30th of September in 2007, and young plants were planted out on 17th of February and on 23rd of November respectively.

The plant density was 4 plants m^{-2}. Seedlings were planted in twin rows (0.4 m) with 0.4 m spacing inside the row and 0.85 m between adjacent twin rows. Plants were arranged in four repetitions by randomly to examine them more detail. Plants were cultivated irrigated with a standard nutrient solution by means of a drip irrigation system, plant training to one stem, supported by a high wire system.

According to Baille et al., (2006), greenhouses were shaded by net to decrease overheating of inner space after the fourth harvest (25 May).

During the experiment we recorded the number and weight of fruits at harvesting, with different harvesting period. Harvested fruits were classed by quality: marketable (fruit with perfect shape and no damaged); and unmarketable low quality (damaged fruit or those with physiological disorders).

Temperature was measured six times per hour (hourly mean were recorded and daily mean were calculated), using a Skye DataHog micrometeorological instrument, sensors placed at the central compartment of the greenhouses.

All pictures were taken by Olympus C3O3O2 mounted on Zeiss stereomicroscope.

All statistical analyses were performed using the Microsoft® Excel 2002 Analysis Toolpak (Microsoft Corporation Corporate Headquarters Redmond, USA).

Results

Little is known about the effects of certain climatically factors, such as relative humidity (RH), light, and temperature (air and root zone temperature), on the Ca content in fruit. Most investigations into RH have dealt with greenhouse plants where RH is controlled around the whole plant. In such plants, results are contradictory. Climate control of low-cost and low-built plastic house is not able to provide optimal temperature during extreme outside temperature conditions. The temperature regime inside plastic tunnel is strongly influenced by outer temperature (Baille et al. 2006). Figure 1 show temperature régime of air and root zone medium in plastic tunnels during examined harvesting period. Despite of shading, average daily air temperature increased above sweet pepper optimum, and it caused higher temperature in root zone medium also. Rockwool slabs temperatures were significantly higher than soil temperature and this was higher for sweet pepper roots than optimal temperature, while soil temperature did not exceed the optimum for sweet pepper.

Parallel to increasing average air temperature in the plastic houses, incidences of BER fruits were increased also. Figure 2 shows stereomicroscopy photographs of cross section cuttings of healthy and BER fruits. Figure 2/B shows (white arrow) the secondary infection of Botrytis cinerea at surface of necrotic tissues in the fruit end.

Initially low incidence of BER fruits increased abruptly to the highest incidence (12.5%) of BER fruits at the end of May. We tried to establish connection between temperature and yield of BER fruit by linear regression analysis. Pepper plants grown in soil have close correlation between BER fruit yield and soil temperature. Both soil and air temperatures took positively effect on BER fruit yield. Figure 3 show relationship between soil and air temperature on yield of BER fruits of sweet pepper in soil. Air temperature effect is stronger than soil temperature, which is resulted from correlation coefficient respectively 0.66 and 0.57.

Sweet pepper plants gown in rockwool slabs reached the maximum incidence of BER fruits at the beginning of June, with 36.3% of marketable yield. The same calculating method was applied to establish connection between temperature and BER fruit incidence grown in rockwool slabs (Fig. 4). Contrary to soil culture, temperature effect of root zone média was stronger than air temperature, which is resulted from correlation coefficient respectively 0.88 and 0.67. Characteristic of air temperature effect was mostly the same in both cultures. Compared sweet pepper grown in soil with soilless culture, relationships between temperature of root zone media and the incidence of BER fruits, there are significant differences (Fig. 4). It can be concluded from the coefficient of linear regression function, that increasing temperature (range between 16-28 °C) of root zone media with 1 °C, increased the incidence of BER fruits with 4% and 1.5% in soilless and soil grown sweet pepper respectively.

Discussion

This study demonstrated that the root environment can induce BER and as a result reduce the yield of sweet pepper fruits. Climate control of greenhouses influences incidence of BER fruits in sweet pepper. Results confirmed that temperature of root zone média take a great effect incidence of calcium deficiency in sweet pepper fruits. Rockwool slabs were reached higher temperature than soil in the investigated greenhouses during the summer harvesting period. Incidence of BER fruits was significantly higher in rockwool than in soil. Temperature effect of rockwool was stronger than soil temperature, which is resulted from correlation coefficient 0.88 of relationship between rockwool temperature and incidence of BER fruits in sweet pepper. Problem of BER in fruiting vegetables especially in sweet pepper is complex, it may be influenced by calcium uptake and the transpiration rate indirectly climate control of greenhouses and it is required following studies.

Figures

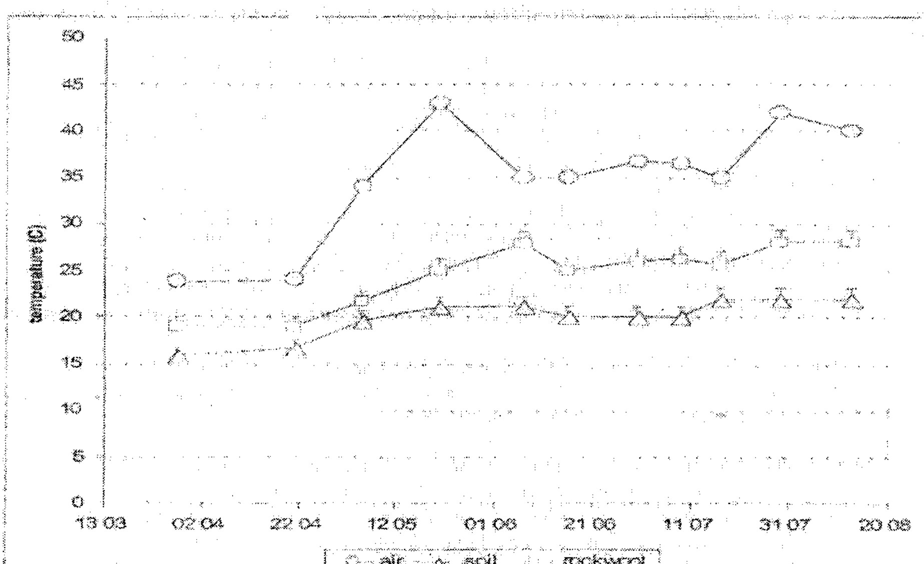

Figure 1. Temperature regimes of air and root zone medium during the experiment. (average±SD, n=4)

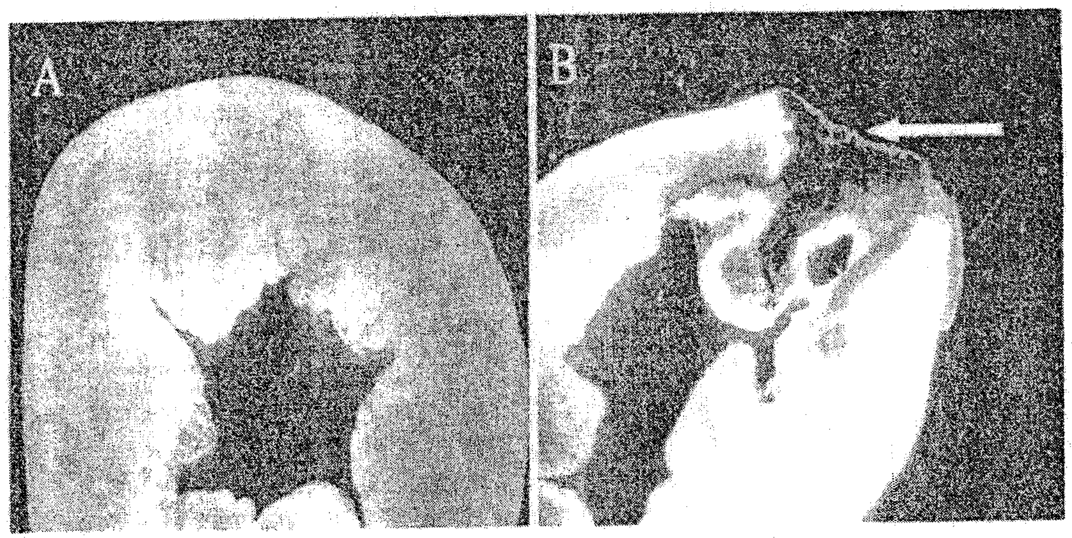

Figure 2. Cross section cuttings of healthy (A) and BER (B) sweet pepper fruits.

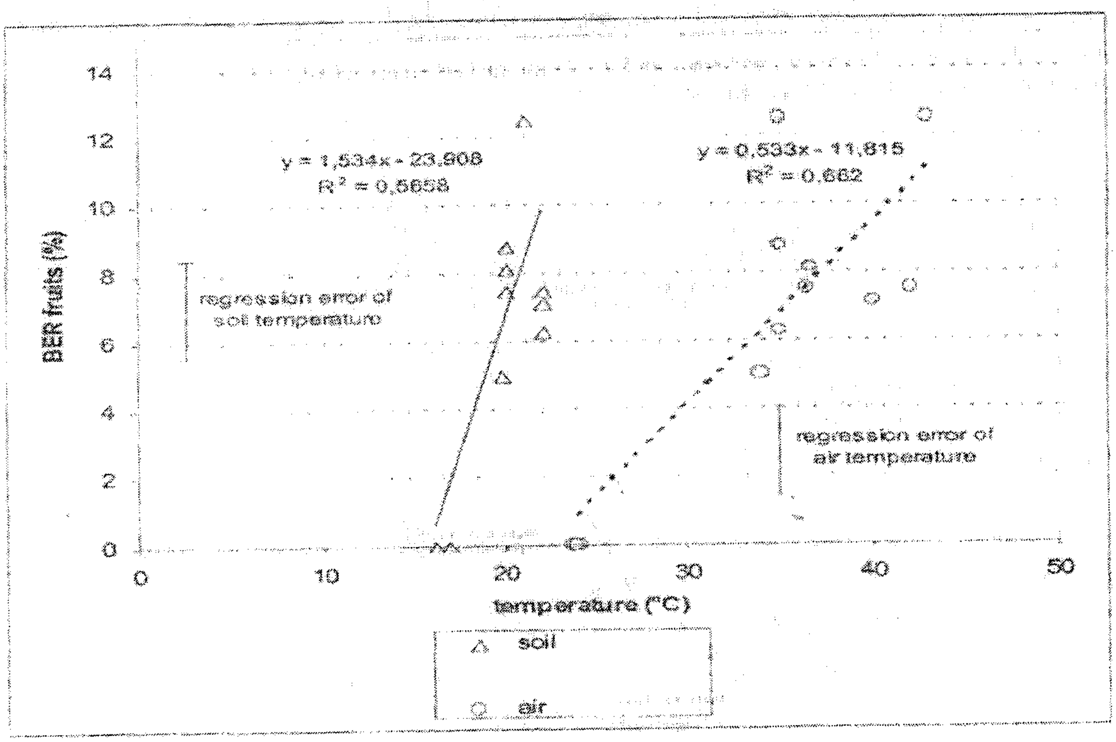

Figure 3. Relationship between root zone and air temperature on incidence of BER fruits in sweet pepper grown in soil. (Variety: Emese Fi, n=11)

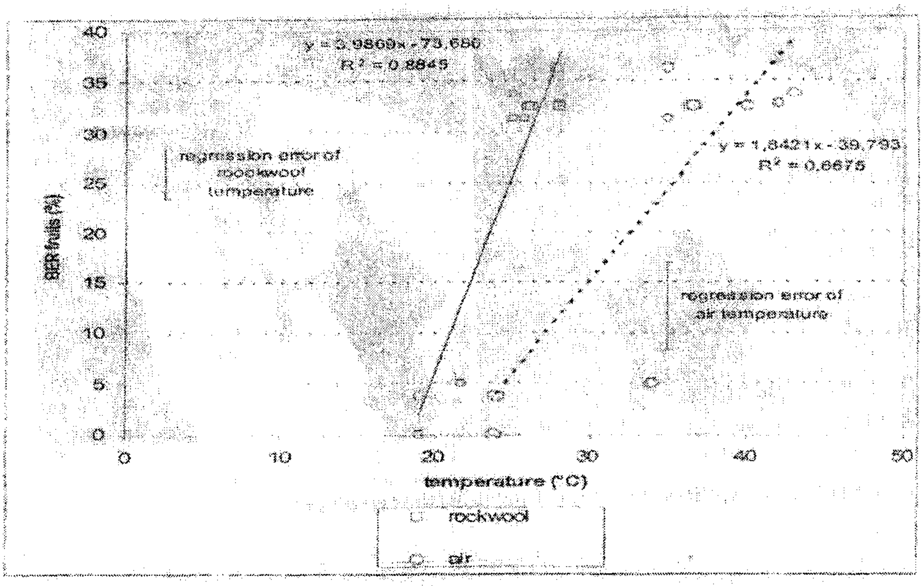

Figure 4. Relationship between root zone and air temperature incidence of BER fruits in sweet pepper grown in rockwool slabs. (Variety: Emese Fi, n=l 1)

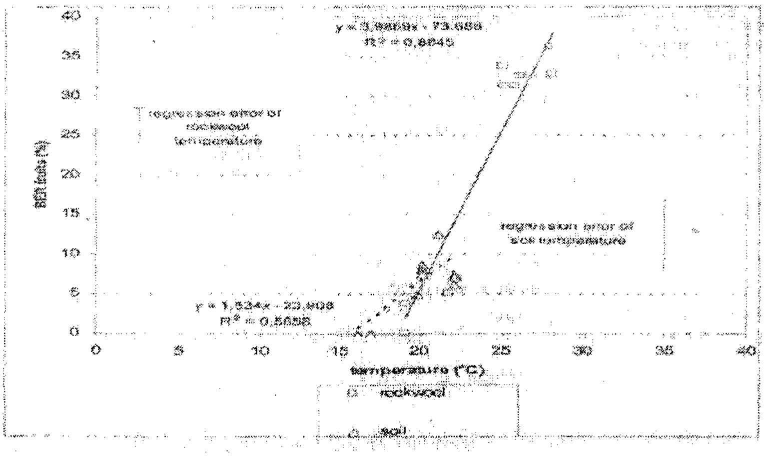

Figure 5. Relationship between root zone temperature on incidence of BER fruits in sweet pepper grown in rockwool slabs and soil. (Variety: Emese Fi, n=l 1)

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