ECOPHYSIOLOGICAL RESPONSES OF SOME VEGETABLE SPECIES CULTIVATED UNDER DIFFERENT GREENHOUSES TECHNOLOGICAL SYSTEMS (ECOLOGICAL AND CONVENTIONAL)

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This paper approached the variations of some ecophysiological parameters of the certain species of vegetables under controlled systems such the greenhouses. The aim of this work is to appreciate the ecophysiological response through the processes of photosynthesis, transpiration and sub stomatalCO_2 concentration. It were studied the ecophysiological response of some varieties of Lycopersicon esculentum Mill. The results were followed the comparative responses of the analyzed species cultivated in conventional and ecologic systems. The analyses concerning processes of photosynthesis, transpiration were performed with LCi portable systems. The transpiration and stomatal conductance were higher after flowering phenophasis in ecological systems, especially in the middle part of the plant. Sugars metabolism in tomatoes was not certainly depending with type of cultivation systems but the monosaccharides and disaccharides were greater until ripening in ecological system of culture in comparison with the conventional one, where these parameters decreased.

***Key words**: photosynthesis, phototranspiration, carbohydrates, crop plants, greenhouse*

Ecologic agriculture developed in Romania beginning with 80 ties. Agriculture in protected spaces(solariums and greenhouses) have a ecologic tendency in last decades. Optimization of physiological process is one demand for the increasing crop production and improving fruit quality. Increasing net assimilation and reducing photorespiration through genetic engineering were some of physiologist preoccupations.

The tomato culture demands large quantities of mineral nutrients, which are supplied by synthetic fertilizers in the conventional cultivation system. In the organic cultivation system only alternative fertilizers are allowed by the certifiers and accepted as safe for humans and environment. There are benefits in both cases.

Our purpose is to evaluate the physiological response in both systems of cultivation through analysis of photosynthetic assimilation and sugars metabolism.

MATERIAL AND METHOD

It was analyzed each variety of tomatoes from two stations studied: Baldwin and Buran from Bacău solarium and respectively, Cherry and Risoca from Bârlad greenhouse. Tomato cultivation in Bârlad greenghouse is the conventional one and tomato varieties in Bacău are cultivated in organic systems since 12 years ago.

The studies concerning the photosynthesis were performed with a portable analyzer LCi –ultracompact (ADC BIoscientific) at some hybrids of *Lycopersicon esculentum* Mill. in different condition of cultivation in protected spaces(greenhouses and solariums). The living leaves of vegetables were analyzed in different parts of plants (basis, middle and top) in phenophasis of flowering, ripening and maturation of fruit.

Also, it was performed the analyzing of the sugars metabolism concerning monosaccharides, dissacharides and polysaccharides by the method Bertrand modified and completed by Borel, 1953. The results were expressed in g of glucose's per cent (g %) from dry matter.

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RESULTS AND DISCUSSIONS

This study followed the variation of some physiological aspects in species cultivated in protected spaces (solariums and greenhouse) under different cultivation systems(organic and conventional). The purpose is to observe if the type of the cultivation systems had the influence over the photosynthesis and as well as the assimilation of carbohydrates processes in some varieties of tomato.

During the flowering until ripening, photosynthesis increased from the top to the middle part of plant correlated with the apparition and development of fruit cluster, which is confirmed by the scientific literature.

Transpiration increased from the basis until top of the tomato plant once with the radiation increasing. Process of transpiration was growing during vegetation phases.

Processes of photosynthesis and transpiration have the same variation no matter the cultivation systems, as well it could be observed from the table below.

Table 1 showed the negative values of photosynthesis rate in leaves of tomato cultivated in solariums of Bacău, meanwhile the photosynthesis rate of the tomato varieties in Bârlad greenhouse varied between 2.9-5.47 $\mu mol\ m^{-2}\ s^{-1}$.

This phenomenon could be happened because of the phototranspiration action. Any increase in carbon dioxide assimilation with increasing light intensity is cancelled out by the increased carbon dioxide release in photorespiration [4, 5]. Higher concentration of carbon dioxide in the atmosphere increase the concentration in the internal air space and thereby increase the rate of photosynthesis, provided light or some other factor is not limiting [3].

Table 1

Variation of photosynthesis, transpiration in leaves of tomato varieties at ripening stage

Station	Species	Parts of plants	Ci(µmol mol^{-1})	A (µmol m^{-2} s^{-1})	E (mmol m^{-2} s^{-1})	Wue(µml/ mmol)
Barlad	Cherry	Basis	342	2.94	2.9	1.01
		Middle	343	11.4	4.99	2.284
		Top	364	4.98	5.47	0.91
	Risoca	Basis	390	1.79	3.03	0.59
		Middle	455	23.12	4.87	4.747
		Top	322	6.11	4.73	1.291
Bacau	Baldwin	Basis	760	-7.98	3.90	-
		Middle	769	-6.51	2.74	-
		Top	759	-3.18	4.16	-
	Buran	Basis	830	-9.97	3.31	-
		Middle	796	-12.22	3.26	-
		Top	951	-13	3.59	-

Legend: Ci-Substomatal cavity CO_2 concentration, A-photosynthesis rate, E-transpiration rate, Wue-water use efficiency

The increasing of the concentrations of CO_2 substomatal (Ci) was observed in tomato varieties of Bacău solarium (Tab. 1). The concentrations of CO_2 in analyzed tomato plants have had approximate two times higher than tomato leaves from Bârlad greenhouse.

Also, Wue (Water use efficiency), A/E ratio is positive only in the tomato varieties cultivated in conventional systems(Bârlad greenhouse). Wue gave the information about the water use in photosynthetic assimilation, more precisely dry mass produced per unity of lost water through transpiration process [7]. Water use efficiency is correlated with assimilation process, greater values are observed in part of plant with higher photosynthesis (generally, in middle part of tomato plant). Apparition of the photorespiration is a process more often observed in crop plants [7].

Approaching this phenomenon we pursued the accumulation of the sugars metabolism in leaves and how the photorespiration influenced the sugars biosynthesis in tomato leaves. To verify this we analyzed the sugars content form tomato leaves in flowering and also in ripening phenophasis.

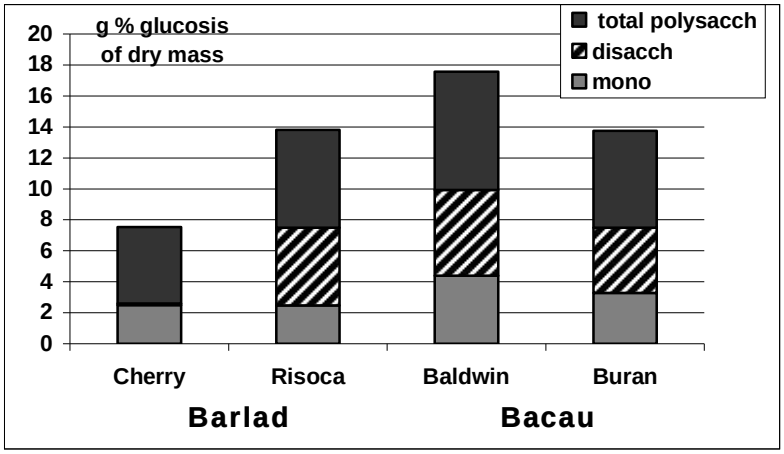

Figure 1 **Accumulation of leaf carbohydrates in tomato varieties at flowering stage in solariums of Bacau and in conventional greenhouse of Barlad**

In flowering phenophasis (*fig. 1*), the distribution of the sugars indicators(mono-, di-and polysaccharides) is almost the same in the tomato varieties analyzed in both of stations (Bacău and Bârlad). Accumulation of high or small quantity of sugars compounds could be different due tomato variety. In greenhouse of Bârlad total sugars in analyzed tomato leaves in Cherry variety have smaller values than all tomato variety analyzed especially, because the disaccharides smallest values, under zero unity.

In ripening phenophasis situation is complete different (*fig. 2*). The higher values of total sugars are observed in tomato varieties in Bacău solarium with all sugars compounds (mono-, di- and polysaccharides) well represented. The amount of disaccharides in tomato varieties (Cherry and Risoca) in Bârlad greenhouse registered the values over 70 % of total sugars from dry mass of plant. In Baldwin and Buran tomato leaves amount of disaccharides registered values of 50 % of total sugars content. In this phenophasis it could be observed the increasing of the disaccharides content in all leaves of tomato varieties. Because of the sugars accumulation in fruit this process is linked with sucrose circulation from the photosynthetically active leaves through phloem sieve to the sink organs.

Total amount of sugars content in leaves of tomato varieties in Bacău station varied from 14 until 25 g % of dry mass of plant. In condition where photosynthetic assimilation exceeds the capacity of sink organs (high light and CO_2 concentrations) there is an accumulation of carbohydrates in the leaves which might trigger a down-regulation of photosynthesis involving a repression of several photosynthetic genes-RuBisCO and tylakoid proteins[2, 4].

Leaf carbohydrates metabolism and phloem loading could also limit photosynthesis under high light and a high CO_2 concentrations [4].

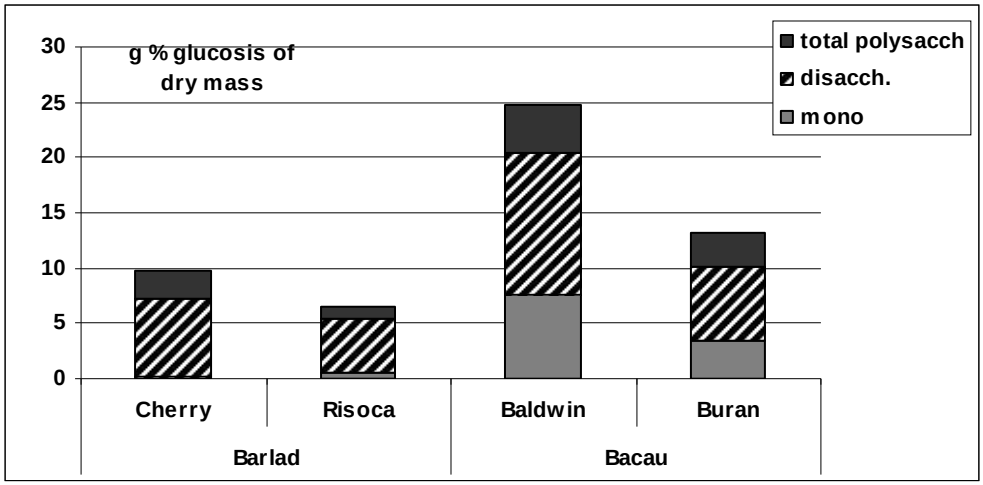

Figura 2 **Accumulation of leaf carbohydrates in tomato varieties at ripenning stage in solariums of Bacau and in conventional greenhouse of Barlad**

The demand of the sink organs influences export from source leaves by a feedback mechanisms operating through some regulatory steps[2].

One step in our case could be the photorespiration which is appearing as an adjustment mechanism to an over accumulation of carbohydrates as was observed in tomato varieties in Bacău solariums. The significant difference between the tomato varieties is the amount of monosaccharides which is lower in Cherry and Risoca varieties (Bârlad greenhouse)(Fig.2). The varieties in Bârlad greenhouse were transplanted with 3 weeks earlier than those from Bacău solarium and that could be a phenomenon of ripening of fruit, as senescence one and the vegetation could be near to ending.

Anyway, the apparition of photorespiration would not consummate the leaf monosaccharides which are higher in these tomato varieties. Photorespiration called "necessary waste "could be implicated in sugars metabolism regulation? When the leaf carbohydrates are over the sink demands correlated with the increasing morning sunlight and CO_2, concentration possibly could be appear the photorespiration to stop the photosynthesis process. These results should be verified in more next observations on the fields.

Sugars metabolism in tomatoes was not certainly depending with type of cultivation systems but the monosaccharides and disaccharides were greater until ripening in ecologic system of culture in comparison with the conventional one, where these parameters decreased.

On the other hand, the missing of the photorespiration would not necessary lead to the increasing of the leaf carbohydrates such it was observed in the tomato varieties in conventional greenhouse. Anyway, are more facts which have to consider that are tomato variety, time of transplantation, and other agricultural practices to confirm the above supposition.

CONCLUSIONS

Investigations after one observations year showed some station influences in tomato varieties cultivated in conventional greenhouse systems(Bârlad) and the other hand in organic solariums(Bacău). Because of the increasing of the light and temperature was observed the higher concentrations of substomatal CO2 in tomato varieties of Bacău solariums. These conditions favorized the installation of photorespiration as a regulatory mechanism to the environmental conditions.

Leaf carbohydrates metabolism (very well represented in tomato leaves of Bacău solarium) and phloem loading could also limit photosynthesis under high light and high CO2 concentrations. Fast rate of photosynthesis in early morning which increased the accumulation of carbohydrates is followed by the apparition of photorespiration process later.

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