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THE INFLUENCE OF PROTECTING METHOD ON PHYSIOLOGICAL INDICES AT CAPSICUM GROWN ON SANDY SOILS

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ABSTRACT

Research conducted in the field of plant physiology aimed at monitoring physiological reactions under the influence of climatic and agrotechnical factors. Agrotechnical factors can lead in order to increase photosynthetic efficiency, which influence qualitative and quantitative the production of pepper grown on sandy soils.

The methods used to protect contributed to achieving a different microclimate, with positive impact both on plant metabolism and the earliness and high production compared to control plants unprotected.

The amount of water in the leaves recorded values between 84 % at plants protected with mulch and 88 % at plants protected with Agryl.

The dried substance has registered values between 12 % at plants protected with Agryl and 16 % at plants protected with mulch. At plants protected with Agryl is ensured an aeration and circulation of air currents, maintaining a maximum foliar humidity.

The rate of photosynthesis in April registered high values at the protected plants, compared with the unprotected plants.

Foliar hydration registered high values due to rainfalls, which ensured a good supply of water at this stage of vegetation.

Leaf transpiration rate recorded high values in May at 12 o'clock, ranging from 7,41 to 11,84 mmol $H_2O/m^2/s$, pepper being a plant that consumes a large amount of water.

INTRODUCTION

Research in the field of plant physiology aims at monitoring the physiological reactions under the action of climatic and agro-technical factors. As a result it can be selected drought tolerant species and varieties for their expansion into the sand culture.

Research by Carpentieri (1990) showed that photosynthetic activity remained stable up to 30 °C, then decreased and inhibited at 40 °C. Plant physiological and biochemical processes are caried out according to microclimate created by applying different protection methods (Voican V. et al., 1998). Under heat stress conditions, the photosynthesis process is inhibited by the decrease in ribulose diphosphate carboxylase enzyme activity after Sage and Cubien in 2007.

Drought determines the concentration of soil solution, reduces foliar absorption by accumulating abscisic acid that closes stomata and increases 100 times in water stress (Salisbury and Ross 1991). Pepper plants are sensitive to water stress during the fruit binding period (Katerji N. et al., 1993). In periods of high temperatures and high light intensity, burns occur on the top of the fruit. At pepper plants, the lesions are characterized by the appearance of white spots and small swelling on the fruit epicarp, then water loss and death of tissues (Nicolae Ion, 2010).

Research on sandy soils highlights the superiority of plant protection from the point of view of the productions and their earliness (Ciuciuc Elena, Ploae Marieta, 2001).

MATERIALS AND METHODS

The experience has been placed in randomized blocks and maintenance work has been provided in the technology of plant cultivation protected on sandy soils. In the period

2012 - 2014, were made determinations regarding diurnal variation of physiological processes as follows:

- water forms and dried substance from leaf by gravimetric method;
- concentration of vacuolar juice in leaves, determined refractometrically;
- diurnal variation of photosynthesis and foliar transpiration, with the LC PRO + portable device.

The researches aimed to establish the most effective method of protecting the capsicum crops by studying the following variants:

- V1 - unprotect;
- V2 - mulch-protected;
- V3 - protected by polyethylene tunnel;
- V4 - protected by tunnel and mulch;
- V5 - protected with Agryl;
- V6 - protected with Agryl and mulch.

RESEARCH RESULTS

Physiological processes have shown a diurnal variation under the influence of climatic factors, varieties studied and the method of protection used.

The amount of water in the leaves was influenced both by the climatic conditions and by the vegetation phase studied. Under the conditions of 2012, the quantity of water in the leaves (Table 1) recorded values between 81,7 % for the unprotected variant and 87 % for the plants protected by tunnel and mulch.

The amount of dried substance in leaves was different during the 3 years of research, in 2012 the unprotected variant with the highest content of dry matter (18,3 %).

The microclimate created in protected plants, thanks to condensation, maintains high hygroscopicity of the air, and the plants metabolism is more intens. The concentration of the vacuolar juice increases at the time of the drought as a defense reaction, avoiding the ineffective loss of water evaporated by foliar sweating. Values ranged between 7,0 – 9,8 %. The maximum (9,0 – 9,8 %) was recorded at unprotected plants and those protected only with mulch because the plants are exposed to the direct action of climatic factors that increase the atmospheric drought.

Table 1

Variation of some physiological indices at capsicum (2012)

Capsicum	Water in lives %	Dry substance %	The foliar surface (mm^2)	Concentraţion of cellular juice %
Unprotect	81,7	18,3	1263	9,8
Mulch-protected	82,0	17,9	1403	9,0
Protected by polyethylene tunnel	86,0	14,0	1614	7,0
Protected by tunnel and mulch	87,0	12,6	2122	7,4
Protected with Agril	83,4	16,6	1077	7,0
Protected with Agril and mulch.	83,4	16,6	1389	8,0

The rate of photosynthesis (Table 2) showed a diurnal variation, being influenced by the climatic factors and the method of protection used.

At 9 o'clock the values were between 1,76 – 6,65 µmol $CO_2/m^2/s$ at 12 o'clock between 8,27 – 17,6 µmol $CO_2/m^2/s$ and at 15 o'clock between 9,15 – 15,95 µmol $CO_2/m^2/s$.

The assimilates are used for the rapid growth of protected plants and the rate of photosynthesis is slightly lower compared to unprotected plants in the first vegetation phases.

The foliar transpiration rate recorded lower values in the morning (1,44 – 3,75 mmol $H_2O/m^2/s$), increased at noon (1,55 – 4,04 mmol $H_2O/m^2/s$) and maintained high at 15 o'clock when the action of stress factors increased. Foliar transpiration values were high in Agryl-protected plants, as this method of protection allows airflows to be circulated.

Table 2

Diurnal variation of physiological processes at capsicum (2012)

Capsicum	Photosynthesis rate µmol $CO_2/m^2/s$			Transpiration rate mmoli $H_2O/m^2/s$		
	9 o'clock	12 o'clock	15 o'clock	9 o'clock	12 o'clock	15 o'clock
Unprotect	1,76	13,80	14,40	1,44	1,55	2,40
Mulch-protected	6,65	17,60	15,95	1,63	1,95	2,46
Protected by polyethylene tunnel	2,46	8,27	9,15	1,89	2,60	3,70
Protected by tunnel and mulch	3,17	16,25	12,47	2,61	4,04	2,75
Protected with Agril	3,29	13,96	10,07	2,43	2,61	3,02
Protected with Agril and mulch.	5,33	17,46	14,67	3,75	3,67	4,60

Under the conditions of 2013 (Table 3), the quantity of leaf water ranged between 84 % at mulch-protected plants and 88 % at Agryl-protected plants.

The dry matter recorded between 12 % at Agryl-protected plants and 16 % at mulch-protected plants. Agryl-protected plants provide aeration and circulation of air flows, maintaining maximum foliar humidity.

The concentration of vacuolar juice is maximal in unprotected plants, providing greater drought resistance. Protected plants also provide foliar hydration under the tunnel, but also in the soil under mulch, so that the concentration of the vacuolar juice is lower, ranging from 7,0 – 7,8 %, because the plants have more water available by protection.

Table 3

Variation of some physiological indices at capsicum (2013)

Capsicum	Wather in the leaves %	Dray substance %	Concentraţion of cellular juice %
Unprotect	84,6	15,4	8,2
Mulch-protected	84,0	16,0	7,8
Protected by polyethylene tunnel	86,3	13,7	7,6
Protected by tunnel and mulch	85,9	14,1	7,0
Protected with Agril	88,0	12,0	7,0
Protected with Agril and mulch.	85,4	14,6	7,6

The photosynthesis rate at 9 o'clock ranges between 13,14 µmol $CO_2/m^2/s$ at Agryl -protected plants and 22,7 µmol $CO_2/m^2/s$ at plants protected by polyethylene tunnel and mulch. At 12 o'clock photosynthesis rate ranged between 14,35 µmol $CO_2/m^2/s$ at Agryl and mulch-protected plants and 25,18 µmol $CO_2/m^2/s$ at tunnel and mulch-protected plants. Tunnel protection provides optimum conditions for photosynthesis, which records

maximum values at this time of day. At 15 o'clock, under the action of climatic factors, the rate of photosynthesis at plants in the tunnel decreases due to overheating of the microclimate under the foil.

The transpiration rate recorded at 9 o'clock values ranging from 1,49 mmol $H_2O/m^2/s$ to mulch-protected plants and 3,20 mmol $H_2O/m^2/s$ at tunnel and mulch-protected plants. Overheating under the tunnel has increased the foliar transpiration rate of plants. At 12, the transpiration rate values ranged between 2,09 mmol $H_2O/m^2/s$ at Agryl - protected plants and 5,74 mmol $H_2O/m^2/s$ at tunnel-protected plants. Agryl ensures circulation of air flows avoiding overheating of the foliar appliance. At 15, the transpiration rate values were reduced to 1,97 mmol $H_2O/m^2/s$ at Agryl-protected plants and maximum 6,06 mmol $H_2O/m^2/s$ at tunnel-protected plants, this is why aeration of plants under the tunnel is taking place when the air temperature increases.

Table 4

Diurnal variation of physiological processes at capsicum (2013)

Capsicum	Photosynthesis rate µmol $CO_2/m^2/s$			Transpiration rate mmoli $H_2O/m^2/s$		
	9 o'clock	12 o'clock	15 o'clock	9 o'clock	12 o'clock	15 o'clock
Unprotect	17,95	17,70	13,15	1,69	3,61	3,92
Mulch-protected	20,04	19,55	10,29	1,49	4,28	3,29
Protected by polyethylene tunnel	13,58	23,8	11,48	2,44	5,74	6,06
Protected by tunnel and mulch	22,7	25,18	9,59	3,20	4,57	5,95
Protected with Agril	13,14	18,44	12,74	1,54	2,09	1,97
Protected with Agril and mulch.	14,7	14,35	9,77	2,80	3,17	2,77

The determinations made in 2014 on the capsicum cultivated on sandy soils highlighted the following:

The amount of leaf water ranged between 79,2 % at Agryl -protected plants and 82,1 % at plants protected with agril and mulch.

Dry substance ranged between 17,9 % at plants protected with Agryl and mulch and 20,8 % at Agryl-protected plants.

The concentration of the vacuolar juice is maximal in unprotected plants of 7,5 %, providing greater resistance to drought. In protected plants, the concentration of the vacuolar juice is lower compared to the years 2012 - 2013, ranging from 6,4 – 7,0 %.

Table 5

Variation of some physiological indices at capsicum (2014)

Capsicum	Wather in the leaves %	Dray substance %	Concentraţion of cellular juice %
Unprotect	80,8	19,2	7,5
Mulch-protected	80,8	19,2	6,9
Protected by polyethylene tunnel	81,9	18,1	6,7
Protected by tunnel and mulch	80,5	19,5	7.0
Protected with Agril	79,2	20,8	6,8
Protected with Agril and mulch.	82,1	17,9	6,4

In April (2014), the photosynthesis rate peaked at 9 o'clock (table 6), at plants protected by tunnel and mulch, being 22,12 µmol $CO_2/m^2/s$, at 12 o'clock at plants

protected with Agryl and mulch, being 20,5 µmol $CO_2/m^2/s$, and at 15 o'clock the plants protected with polyethylene tunnel being 19,60 µmol $CO_2/m^2/s$. At noon, when the air temperature is high, the Agryl cloth allows for optimal aeration of plants and positively influences the rate of photosynthesis.

The foliar transpiration rate ranged between 2,45 – 4,99 mmol $H_2O/m^2/s$ at 9 o'clock, between 3,72 – 5,72 mmol $H_2O/m^2/s$ at 12 o'clock and at 15 o'clock between 2,05 – 5,86 mmol $H_2O/m^2/s$ (diurnal maximum at Agryl-protected plants). The polyethylene film does not permit airing and the stomata are closing, reducing water evaporation, compared to the Agryl cloth providing good ventilation, thus increasing the foliar sweating rate.

Table 6

Diurnal variation of physiological processes at capsicum (2013)

Capsicum	Photosynthesis rate µmol $CO_2/m^2/s$			Transpiration rate mmoli $H_2O/m^2/s$		
	9 o'clock	12 o'clock	15 o'clock	9 o'clock	12 o'clock	15 o'clock
Unprotect	10,02	13,67	12,53	3,04	5,24	3,57
Mulch-protected	12,28	12,51	15,37	3,01	3,98	2,85
Protected by polyethylene tunnel	14,77	15,25	19.60	4,57	5,72	2,05
Protected by tunnel and mulch	22,12	6,31	17,81	4.99	3,72	4,05
Protected with Agril	9,56	24,4	17,22	3,82	4,55	5,86
Protected with Agril and mulch.	11,24	20,5	10,76	2,45	4,35	4,75

The production of capsicum pepper registered values ranging from 37,4 tons / ha at unprotected plants and 45,7 tons / ha at plants protected with Agryl and mulch.

CONCLUSIONS

The climatic conditions, the protection method and the cultivated species influenced the physiological processes studied.

The methods of protection used contributed to the achievement of a different microclimate, with a positive influence on both the metabolism of plants and the earliness and high production compared to unprotected plants.

The rate of photosynthesis in April was high at protected plants compared to unprotected plants.

Foliar hydration recorded high values due to rainfall (especially in 2014), which ensured a good water supply at this stage of vegetation.

The polyethylene film does not permit the ventilation of the plants and closes the stomata, reducing water evaporation, compared to the Agryl cloth providing good ventilation, thus increasing the foliar sweating rate.

Following the results obtained, we can select the most effective method of protection in order to obtain the largest and the earlyest productions. The earlynest production is ensured by climatic conditions with a thermal surplus on vegetable plants grown on sandy soils and increases the profit of the crop by capitalizing the production at high prices.

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