THE INFLUENCE OF MULCHING AND OF THE DRIPPING IRRIGATION OVER THE EARLY PRODUCTION AND THE QUALITY OF GREENHOUSES CULTIVATED TOMATO FRUIT

Cărbunar Mihai*, Popovici Mariana**

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania, e-mail: carbunar@yahoo.com, mariana_mediu@yahoo.com

Abstract

The tomatoes represent the basic culture in greenhouses. The early tomato production together with the quality of the fruit represent the most important parameters in the establishment of the greenhouse cultivated tomatoes' economic efficiency. The poli factor experience with the following factors: cover foil, irrigation through drippingand mulching offer actual data that can be introduced in the basic technology of tomato cultivation in covered places.

Key words: dripping irrigation, mulching, long term foil.

INTRODUCTION

For the culture of tomatoes in the majority of the European countries, the early 20th century meant the beginning of its trade. The pleasant taste, associated with the fruit high content of vitamins, sugars, mineral substances, amino acids and organic acids have made the expansion of the tomatoes possible, being considered nowadays the basic crop in the vegetable cultivation.

Being thermophilic plants, the cultivation of tomatoes in spaces protected with glass or polyethylene foil allows the expansion of consumption over an extended period of the year.

Through the microclimate they create inside, the spaces covered with polyethylene foil strongly influence the physiological processes of the tomatoes. Aspects related to the influence of the environment factors upon the growing, flowering and fructification processes have been the object of study for a lot of researchers.

Thus, the low temperature treatments applied to the seedling lead to a great number of flowers in the first inflorescence (Calvert 1955, Indrea 1962). At 15^{o}C less leaves are formed before the first inflorescence in comparison with the number of leaves formed at 25^{o} C; the dimension of the apex is twice as big and the plants start to blossom earlier (Stan 1979, Aung 1979 quoted by Petrescu and Popescu 1992). Nisen (in 1993) notices that the temperatures lower than 17^{o} C are the cause of fruit malformation.

Cooper's research (1964) shows that, when the day is short, the tomatoes blossom later.

In Hungary, Somas (1975) has established that the plant does not produce fruit at intensity under 5000 luxes. The number of days until the floral initiation decreases as the light intensity increases (Kinet 1977, quoted by Ruxandra Ciofu). Andronicescu et.al., (1970) show that the level of soil humidity is of 68-70% from the field capacity in the first growing phases and of 78-81% during the fructification period. The delay of the irrigations leads to a hydric stress in the soil and to final negative consequences over the agricultural production (Domuţa 1995). More researchers (Shmeli and Goldberg, quoted by Pricop et. al., 1971, Saviţchi 1982, quoted by Indrea 1992) have proved the advantages of the dripping irrigation in what the production increase is concerned in comparison with other irrigation methods, not only for tomatoes but also for melons and corn.

The mulching of the soil with synthetic materials provides a lot of advantages: it maintains the soil humidity, it increases the temperature of the soil by 6-7^{o} C, it limits the loss of nutritious elements through washing, it encourages the accumulation of carbon dioxide in the soil surface, it inhibits the growth of weeds (Chaux, Foury 1994).

MATERIAL AND METHOD

The research was conducted in 2009 in a vegetable micro-farm from Husasău de Tinca, a locality situated in the north-west of Romania. The biological material used was the Cristal F_1 tomato hybrid.

In order to achieve the aims and the objectives that we had in view a poli factorial experiment had been organized, of the 2x2x3 type, having the following gradualism:

Factor: F – foil to cover the greenhouse
- F_1 – polyethylene foil
- F_2 – long term foil (Luminal 4)

Factor I – type of dripping devices in the dripping system
- I_1 – T- tape drip
- I_2 – micro tubes

Factor M – the soil mulching material
- M_1 – non-mulched
- M_2 - mulched with transparent foil
- M_3 – mulched with black foil

From the combination of the three factors 12 experimental variants have turned out which have been set in three repetitions, in subdivided blocks. The statistic processing of the data has been done through the variant analysis.

RESULTS AND DISCUSSIONS

The early tomato production obtained in greenhouses represents an important element that influences the crop profitability as the capitalization price of these tomatoes is higher.

Being an experiment with three factors, firstly we analyzed the influence of each factor, then we proceeded to the bilateral interaction of the factors and finally the interaction influence of the three factors upon the early production level.

Table 1 presents the influence of the irrigation method and of the cover foil. The irrigation with the two types of drips did not have a significant influence upon the early tomato production either in the greenhouse covered with normal foil or in the one covered with long term foil.

Table 1

The influence of drip irrigation method on the early tomato yield in tunnels covered with ordinary foil (PE) and with long duration foil (Luminal 4), Husasău de Tinca, 2009

Variant		Absolute production t/ha	± D t/ha	Relative production %	Signifi cance
Foil to cover	Type of dripping				
PE	Micro tubes	32.74	-	100	-
	T- tape	33.87	1.12	103.4	-
Luminal 4	Micro tubes	45.39	-	100	-
	T- tape	48.47	3.08	106.8	-

LSD 5% = 4.84;
LSD 1% = 7.10;
LSD 0.1% =11.14

The mulching of the soil in the tomato crop positively influences the early production both in the greenhouse covered with normal foil and in the one covered with long term foil (table 2).

Table 2

The influence of mulching method on early tomato yield in tunnels covered with ordinary foil (PE) and with long duration foil (Luminal 4), Husasău de Tinca, 2009

Variant		Absolute production t/ha	± D t/ha	Relative production %	Signifi cance
Foil to cover	Type of mulching				
PE	Non-mulched	21.45	-	100	-
	Transparent foil	46.28	24.83	215.8	xxx
	Black foil	32.18	10.73	150.0	xxx
Luminal 4	Non-mulched	32.5	-	100	-
	Transparent foil	52.18	19.68	160.6	xxx
	Black foil	56.10	23.6	172.6	xxx

LSD 5% = 4.71;
LSD 1% = 6.33;
LSD 0.1% =8.34

Thus, in comparison to the non-mulched variant, the mulch with transparent foil led to a production higher with 24.83t/ha in the greenhouse covered with normal foil and to a production higher with 19.68t/ha in the greenhouse covered with Luminal 4 foil. The mulching with black foil also leads to an increase in the early production in both types of greenhouses in comparison with the non-mulched crop, the effect being more obvious in the greenhouse covered with Luminal 4 where it obtains an increase of 23,6t/ha and of only 10.7t/ha in the greenhouse covered with PE.

Table 3 presents the way in which the two types of drips have behaved in the mulching variants. In the case of the transparent foil mulching both types of drips have the same effect upon the early production. At the black foil mulching the excess of 12.2% obtained for the T-tape drips is close to the limit difference P=5%.

Table 3

The influence of drip irrigation method and soil mulching on early tomatoes yield in tunnel, Husasău de Tinca, 2009

Variant		Absolute production t/ha	± D t/ha	Relative production %	Signifi cance
Type of mulching	Type of dripping				
Non-mulched	Micro tubes	26.33	-	100	-
	T- tape	27.62	1.28	104.9	-
Transparent foil	Micro tubes	49.27	-	100	-
	T- tape	49.20	-0.07	99.9	-
Black foil	Micro tubes	41.60	-	100	-
	T- tape	46.68	5.08	112.2	-

LSD 5%=5.14 ;
LSD 1%=7.17;
LSD 0.1%=10.23

The data related to the early tomato production in greenhouses, under the combined influence of all the studied factors emphasize the best variants (table 4).

Table 4

Early tomato yield obtained in tunnels covered with ordinary foil (PE) and long duration film (Luminal 4) in conditions of irrigation with two types of dripping tubes (T-tape and micro-tubes) in non-mulched and mulched crops with transparent and black film, Husasău de Tinca, 2009

Variant				Absolute production t/ha	± D t/ha	Relative production %	Signifi cance
Nr.crt.	Foil to cover	Irrigation	Mulching				
I	PE	T-tape	Non-mulched	21.77	100	-	-
II			Transparent foil	44.07	202.4	22.3	xxx
III			Black foil	35.77	164.3	14.0	xxx
IV		Micro tubes	Non-mulched	21.13	100	-	-
V			Transparent foil	48.50	229.5	27.37	xxx
VI			Black foil	28.60	135.4	7.47	x
VII	Luminal 4	T-tape	Non-mulched	33.47	100	-	-
VIII			Transparent foil	54.33	162.3	20.86	xxx
IX			Black foil	57.60	172.1	24.13	xxx
X		Micro tubes	Non-mulched	31.53	100	-	-
XI			Transparent foil	50.03	158.7	18.5	xxx
XII			Black foil	54.60	173.2	23.07	xxx

LSD 5% = 6.05;
LSD 1% = 8.33;
LSD 0.1% =11.47

The early production resulting from the 12 experimental variants varied from 21,13 to 57.6t/ha., being higher in the greenhouse covered with long term foil, in the culture irrigated through dripping with T-tape devices and mulched with black foil with an extremely significant excess of 24.13t/ha in comparison with the non-mulched variant. This one is followed by the variant cultivated in the same conditions but irrigated with micro tubes, with a production of 54.33t/ha and an excess of 23.07t/ha extremely significant in comparison with the non-mulched variant. The differences between the two variants are not statistically ensured.

In the greenhouse covered with normal foil the productions have generally been lower but the differences between the mulched and the non-mulched variants have been higher reaching excesses of 27.37t/ha in the variant mulched with transparent foil and irrigated with microtubes.

The quality of the tomato fruit expressed in the 3 quality steps is presented in table 5.

Table 5

The commercial quality of tomatoes

Variant				Early Production	Extra quality		The 1st quality from the total		The 2nd quality from the total
Nr. crt.	Foil to cover	Irrigation	Mulching		t/ha	%	t/ha	%	t/ha
I	PE	T-tape	Non-mulched	21.77	13.38	61.5	5.52	25.4	2.45
II			Transparent foil	44.07	26.53	60.2	9.12	20.7	8.42
III			Black foil	35.77	26.97	75.4	5.29	14.8	3.51
IV		Micro tubes	Non-mulched	21.13	11.36	53.8	5.59	26.5	4.18
V			Transparent foil	48.50	33.99	70.1	6.98	14.4	7.62
VI			Black foil	28.60	18.21	63.7	7.03	24.6	3.36
VII	Luminal 4	T-tape	Non-mulched	33.47	23.93	71.5	4.08	12.2	2.07
VIII			Transparent foil	54.33	45.96	84.6	6.30	11.6	2.07
IX			Black foil	57.60	46.02	79.9	8.29	14.4	3.29
X		Micro tubes	Non-mulched	31.53	21.25	67.4	7.22	22.9	3.06
XI			Transparent foil	50.03	38.77	77.5	10.15	20.3	1.11
XII			Black foil	54.60	42.47	77.8	10.86	19.9	1.27

When performing an assembly analysis of the tomato fruit quality it can be noticed that the majority of the production (over 50%) from all the variants is represented by an extra quality. The influence of the cover foil and of the irrigation method are less significant but in turn quite big differences can be noticed between the mulched and the non-mulched variants.

The variant covered with long term foil, irrigated with T-tape and mulched with transparent foil has obtained the highest quantity of extra quality fruit (84.6). The second quality fruit have been in pretty small quantities in all the variants.

CONCLUSIONS

The experiment related to the influence of the cover foil, of the irrigation through dripping and of the mulch on the early tomato production and on the trade quality has led to the following conclusions:

1. Covering the greenhouses with long term foil has the advantage that they can be used for a long time and they also ensure more favorable micro climate conditions.
2. The mulching of the soil using polyethylene foil strongly influences the vegetation and fructification of the plants improving the thermal gradient of the soil in the first part of the vegetation and also simultaneously improving the water regime in the soil.
3. The researched factors taken separately have had a positive effect upon the early tomato production but when taken together the effect has been more significant.
4. The highest influence upon the early production has been noticed in the variant covered with long term foil, irrigated through the T-tape method and mulched with black foil (57.60t/ha).
5. The researched factors have also had a great influence on the quality of the tomato fruit.
6. The most important extra quality production has been obtained in the variant covered with long term foil, irrigated through the T-tape method and mulched with transparent foil (84,65%).

REFERENCES

1. Andronicescu, D., şi colab., 1970, Soiuri de legume. Ed. Ceres, Bucureşti.
2. Apahidean Al. S., Maria Apahidean, 2001, Legumicultură specială, Ed. Academic Press, Cluj-Napoca.
3. Botzan, M., 1966, Culturi irigate. Ed. Agrosilvică, Bucureşti.
4. Brun, R., 1992, Le plastique en agriculture. Revue Horticole, p. 393.
5. Buzescu D., 1994, Metoda de irigare factor important pentru realizarea echilibrului hidric în cultura legumelor, Hortinfom.
6. Calvert A., 1955, Temperature efect on early growh and development in tomato, Intern.Hort. Congress, Rep. of the XIV-the.
7. Cazacu E. şi colab., 1989, Irigaţii, Ed. Ceres, Bucureşti.
8. Chibane A., 1999, Fise technique, tomate sous serre. Buletin mensuel d`information de la laison du PNTTA – 6.
9. Ciofu Ruxandra şi colab., 2004, Tratat de legumicultură, Ed. Ceres, Bucureşti, 2004.
10. Cooper A., J., 1964, The effect of light intensity, day temperature on fruit ripening and yield of tomato. J.Hort.Sci, 39.
11. Choux CI., Foury CI., 1994, Productions legumieres vol. I-III, Lavoisier, TEC/DOC, Paris.
12. Domuţa C., şi colab., 2000, Irigarea culturilor, Ed. Univ. din Oradea.
13. Drăghici, Elena, Ruxandra Chiofu, 1998, Influenţa mulcirii solului cu diferite materiale asupra salatei în cultura protejată. Lucrări stiinţifice, USAMV, Bucureşti.

14. Grumeza N., Dragomirescu O., 1993, Irigaţii prin picurare. Ed. Ceres, Bucureşti.
15. Indrea D., 1992, relaţiile plantelor legumicole cu factorii de mediu, În legumicultură de Butnariu H., şi colab., EDP, Bucureşti.
16. Grumeza N., Dragomirescu O., 1993, Irigaţii prin picurare. Ed. Ceres, Bucureşti.
17. Nisen, A., Deltour, 1981, Consideration pratique sur le transmission du rayonement solaire et de haleur pur le materiaux utilisees in seres. INSRA, Bruxelles.
18. Petrescu, C., Popescu, V., 1992, Tomatele, în Legumicultura de Butnariu H. şi colab., EDP, Bucureşti.
19. Pricop Gh., Grumeza N., Dorobanţu M., 1971, Metode de irigare, Ed. Ceres, Bucureşti
20. Somos A., 1975, Zoldsegtermesztes, Akad. Kiado, Budapest.
21. Stan N., Stan Th., 1999, Legumicultură, vol. I, Ed. ,,Ion Ionescu de la Brad", Iaşi.