FOLIAR FERTILIZATION EFFECT ON PRODUCTION AND METABOLISM OF TOMATO PLANTS

Iulia ANTON*, A. DORNEANU*, Geanina BIREESCU, Carmen SÎRBU*, Venera STROE*, Adriana GRIGORE***

National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection of Bucharest
****Biological Research Institute of Iaşi***
E-mail: lia_6782000@yahoo.com

Abstract: *The practice of modern agriculture, sustainable, requires a lot of professional competence, and permanent monitoring of vegetation factors, among which those of nutrition have an important role (DAVIDESCU et al., 1992).*
In order to optimize the nutrient regime in soil-plant system were created in the INCDPAPM - ICPA Bucharest in collaboration with ICB – Iasi science research to test on products with foliar application for their inclusion in the list allowed to use of fertilizers in Romanian agriculture. Research was conducted in 2010, in the University of Agronomic and Veterinary Science and Medicine, Iasi, experimental field of the SDE V. Adamachi (horticultural farm Adamachi and Ezăreni ranch) the have proposed specially taste productive efficiency on four fertilizing products.
The testing methodology consisted of those products by foliar application (fine spray on plants) in three treatments, as dilute solutions in concentrations of 0.1 - 1.0% and the amount (volume) of 500 liters solution / ha. The first treatment was applied 2 weeks after seedling planting and the two others at weeding at 14 days between them. The soil on which they are located the experiences are hortic antrosol and cambic chernozem from the SDE USAMV, Iasi, with a potential for high fertility. The main physical and chemical qualities of soil are presented both in unfertilized control variant, but sprinkled with water, and also for highly productive variants, foliar fertilized. For the experimental vegetable field cambic chernozem I prepared a sheet on specific ecological, with 20 major ecological factors and determinants, soil and climatic on site specific, regional and local (the steppe of the NE region) wich were enrolled in eight classes of size quantitative and six qualitative grades on environmental favorability. Following research has found that foliar fertilizers used to tomato, Izmir cultivar, during vegetation plants, provide significant production increases statistically both in solar and in field, compared with control unfertilized.

Key words**:** *tomato, foliar fertilizers, environmental*

INTRODUCTION

Optimization of all factors and growing conditions ensure intensive use and metabolism in harvest on trophicity chemical factors preventing while the phenomenon of entropic dissipation and hence their environmental pollution (DORNEANU et al., 1976, 2003; BORLAN et al., 1990, 1995).

Because of reduced coefficients for use in crop on nutrient, and the dissipation of entropy, on the soil profile, a significant quantity of chemical fertilizers applied to soil, excess fertilizer can lead to chemical pollution of soil, and agricultural production groundwater and surface water (BORLAN et al., 1990; DORNEANU et al., 1976).

Among the unconventional means of action on the internal environment of plants, to reduce the entropy dissipation of nutrients on the soil profile and to increase the degrees of productive use of nutrients in harvest, the newly created foliar products are part of research topics for their introduction in the Romanian agriculture (DORNEANU, 2003, 2007; DANA, 2006, 2007; BIREESCU, 2007; ANTON, 2008).

The results research of field, solar and green houses with foliar fertilizers determined

their recommendation and implementation in the agricultural and horticultural practice, globally. This has encouraged progressive production of foliar fertilizers in many countries, both for their local use and export (EL FOULY, 2002, DORNEANU et al., 2001, 2005; BIREESCU, 2006, MENGEL, 2002; DORNEANU, 2003 , 2007; DANA, 2006; BIREESCU, 2007; ANTON, 2008, 2010).

Foliar fertilizers are preferred by many countries (EL FOULY, 2002; MENGEL, 2002) as it was found that they have special advantages such as:

- Provides enrichment plants with nutrients, micronutrients, minerals and vitamins that improve plant health, helping to increase production;
- Are 100% water soluble and easy to apply;
- Stimulates the production of microbial biomass, by increasing the fertility of the soil;
- Prevent the development of pathogens in plants;
- Stimulates health plant;
- Determine the production of compounds that stimulate natural defense mechanisms of plants.

Foliar fertilization can be applied in conditions decrease the availability degree of nutrients in the soil, the hard consistency of dry soil and roots under reducing activity during the reproductive period. It is also beneficial to increase the Ca2 + content in fruit and protein content in grain. However, the effectiveness of foliar fertilization depends on the mobility of nutrients in plants. Thus, for phloem-mobile nutrients, the effectiveness of their application is successful (WÓJCIK, 2004).

KNOCHE et al. (1994) showed that there is a strong correlation between the concentration of nutrients applied to the leaf surface and their penetration rate in epidermal cells.

Foliar fertilization with macronutrients as a complementary technique can improve mineral nutrition in plant tissues and can create, of course, a nutritional balance that makes the plants to withstand stress conditions and also to ensure satisfactory yields increases (SHAABAN et al., 2004).

MATERIAL AND METHODS

The research was conducted in 2010, in the University of Agronomic and Veterinary Science and Medicine, Iasi, experimental field of the SDE V. Adamachi (horticultural farm Adamachi and Ezăreni ranch) the have proposed:

- Increasing the productive potential of soil under conditions of environmental protection;
- The establishment of unpollution technologies fertilization;
- Testing of new romanian and foreign fertilizers;

To this end, there have been monofactorial experiments in field and solar on tomato, Izmir cultivar, and were tested according to the following experimental scheme:

V_1 – Control , sprinkled with water;
V_2 – Accele-GRO-M – 0,1%;
V_3 – Accele-GRO-M – 0,3%;
V_4 – Nutrivant Plus Tomato – 1%;
V_5– Fertel F – 1%.

The testing methodology consisted of those products by foliar application (fine spray on plants) in three treatments, as dilute solutions in concentrations of 0.1 - 1.0% and the amount (volume) of 500 liters solution/ha. The first treatment was applied 2 weeks after seedling planting and the two others at weeding at 14 days between them.

Sheet on ecological specific

For the experimental vegetable field cambic chernozem I prepared a sheet on specific ecological, with 20 major ecological factors and determinants, soil and climatic on site specific, regional and local (the steppe of the NE region) wich were enrolled in eight classes of size quantitative and six qualitative grades on environmental favorability (fig. 1).

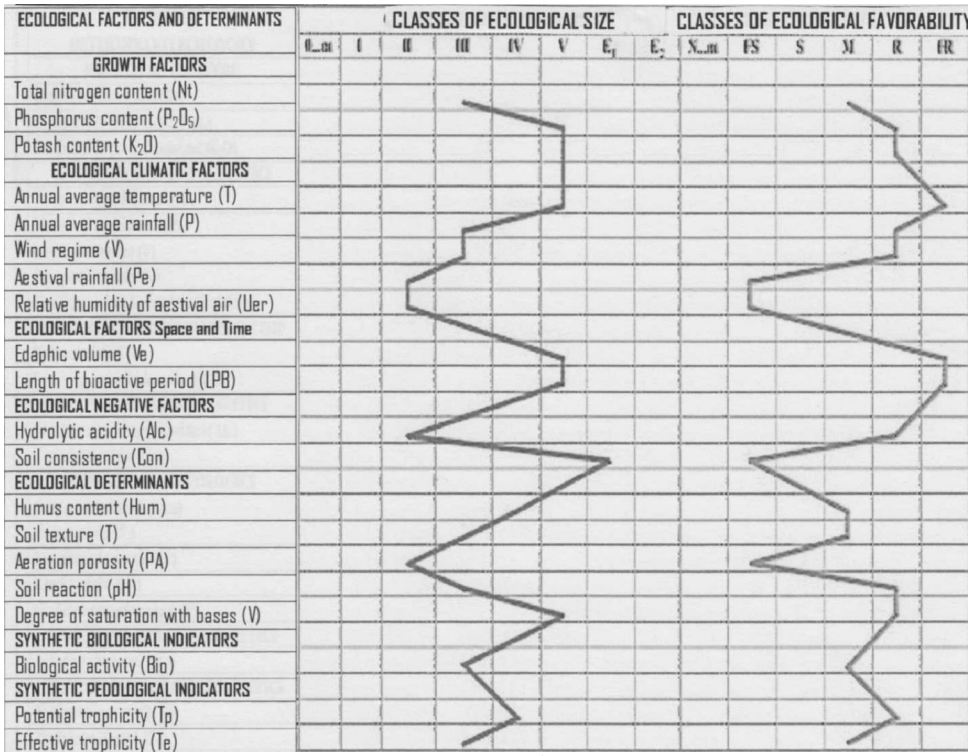

Figure 1: Sheet on ecological specific, **SDE-USAMV Iaşi**

Ecological analysis of regional and local context of the study area reveals the following:

- In class II small size fits two stressful ecological factors by absence (low summer rainfall, low relative humidity air summer), a factor negatively pedoecological (alcalinity low), a stressful pedoecological determinant by absence (porosity aeration);
- The major factors and ecological determinants fits in the classes by middle size III and IV (total nitrogen content, average annual temperature, annual average rainfall, wind regime, the middle humus content, fine middle soil texture, slightly alkaline soil reaction, biological activity middle stressed in the dry season, potential and effectively trophicity with high values (megatrophic soil);
- In the V class by high size fits two pedoecological factors, condition by space and time (the length of bioactive period and edaphic volume), two growth factors pedoecological (mobile phosphorus and potassium content) and a pedological determinant (degree of saturation with bases), average annual temperature;
- In extreme excessive, stressful and limited class for plants to the irrigated regime,

fit the tough consistent summer on dry soil.

As regards framing in favorability ecological classes, of quality point of view, most of the ecological factors and determinants fits in middle and high favorability ecological classes. In middle favorability ecological class are included: total nitrogen content, humus content, soil texture, biological activity and effective trophicity on soil in local ecological context.

The low favorability class includes: summer rainfall, relative humidity air summer, hard consistency of the soil and aeration porosity.

The high favorability class includes: low alcalinity, trophicity potential, soil reaction, degree of saturation with bases, contents of mobile phosphorus, assimilable potassium content, annual average rainfall and wind regime.

In a very high favorability class falls three ecological factors: the average annual temperature, the edaphic volume and the length bioactive period.

But note that 2010 was an atypical year in terms of amount of rainfall in early summer and early fall, August is dry, steppe specified in NE Romania, with influences from Russian steppe.

On tomatoes in the field (Izmir cultivar) all three foliar treatments in 500 liters solution/ha were made during the growing season. The topsoil is fertilized ($N_0P_0K_0$) and irrigated. The tomatoes plants were irrigated by sprinkler before and after planting.

RESULTS AND DISCUSSIONS

The soil on which they are located the experiences are hortic antrosol and cambic chernozem from the SDE USAMV, Iasi, with a potential for high fertility. The main physical and chemical qualities of soil are presented in Table 1, both in unfertilized control variant, but sprinkled with water, and also for highly productive variants, foliar fertilized.

Table 1

The main physical and chemical qualities of soil

Ecopedotop	Specification	Clay under 0.002mm	Text. cls.	Porosity of aeration	EC mS/cm	pH in H_2O	Humus %	Nt %	P_{AL} ppm	K_{AL} ppm	SB me	T me	V%
SDE USAMV Iasi 20.07. 10 *Antrosol hortic 0-20cm*	Tomato in solar 1-row of plants	36.2	T	23	0.269	7.01	3.865	0.272	89	214	30.5	33.1	95
	Tomato in solar 1-interspace	35.4	T	16	0.281	7.12	3.952	0.281	93	238	32.3	34.5	96
SDE USAMV Iasi 20.07. 10 *Cernoziom cambic 0-20cm*	Tomato in field, row of plants	33.8	TT	15	0.351	6.27	3.571	0.238	53	163	28.7	33.4	92
	Tomato in field, interspace	35.3	TT	9	0.413	6.73	3.742	0.287	62	176	30.4	34.9	94

The products tested were statistically achieved production increases (Table 2), very significant, ranging between 30.52% (Accele-GRO-M - 0.1%) and 40.61% (Nutrivant Plus Tomato -1%). Increase energy production from 6866 Mcal/ha (Control) to 9655 Mcal/ha through foliar fertilization with Nutrivant Plus Tomato - 1%.

Energy balance (net energy gain) increases very significantly with values ranging between 20.47% (Accele-GRO-M - 0.1%) and 29.80% (Nutrivant Plus Tomato -1%).

Foliar fertilization positively affects the average weight of fruit per plant (growth - 30.34% Accele-GRO-M - 0.1% respectivelly 47.52% and Nutrivant Plus Tomato-1%), vitamin C content (12.84 mg/100 g f.s. - Control variant and 17.04 mg/100 g f.s. - Nutrivant Plus Tomato -1%) and percentage of first quality fruits (to 41% - Control variant up to 57% -

Nutrivant Plus Tomato - 1%), (Table 3).

Table 2

Energy and productive efficiency on tomato fertilization in field (Izmir cultivar)

Variants	Average prod. (kg/ha)	Productiv efficiency (kg/ha)			Energy efficiency (Mcal/ha)					
		Dif.	%	Smn.	OUTPUT	INPUT	Balance	dif	%	Smn.
Control , sprinkled with water	25431	-	100	-	6866	2403	4463	-	100	-
Accele-GRO-M – 0,1%	33193	7762	130.52	xxx	8962	3585	5377	914	120.47	xxx
Accele-GRO-M – 0,3%	33981	8550	133.62	xxx	9175	3670	5505	1042	123.34	xxx
Nutrivant Plus Tomato – 1%	35759	10328	140.61	xxx	9655	3862	5793	1330	129.80	xxx
Fertel F – 1%	34640	9209	136.21	xxx	9353	3741	5612	1149	125.74	xxx

DL 5% - 3458 kg/ha
DL 1% - 5026 kg/ha
DL 0.1% - 7010 kg/ha

DL 5% - 395 Mcal/ha
DL 1% - 567 Mcal/ha
DL 0.1% - 802 Mcal/ha

Table 3

Foliar fertilizers influence on productivity and quality indices in field on tomato (Izmir cultivar)

Variants	Average weight fruits				C vitamin (mg/100 g s. pr.)	Fruits quality (%)				
	Gramme	Dif.	%	Sm.		Cal. II	Cal. I	Dif.	%	Sm.
Control , sprinkled with water	606	-	100	-	12.84	59	41	-	100	-
Accele-GRO-M – 0,1%	829	223	130.34	xxx	15.17	47	53	12	129.27	xxx
Accele-GRO-M – 0,3%	849	243	140.10	xxx	16.08	46	54	13	131.82	xxx
Nutrivant Plus Tomato–1%	894	288	147.52	xxx	17.04	43	57	16	139.04	xxx
Fertel F – 1%	866	260	142.90	xxx	15.98	44	56	15	135.78	xxx

DL 5% - 112 gramme
DL 1% - 156 gramme
DL 0.1% - 204 gramme

DL 5% - 6%
DL 1% - 8%
DL 0.1% - 10%

Table 4 is shown the influence of foliar fertilization on the assimilating pigment content in fresh leaves of tomato into the field, harvested on 10 days after foliar application of the last treatment. Thus, by foliar fertilization increases both assimilation pigment content of each part, and the total assimilatory pigments content (from 36.02% - Accele-GRO-M - 0.1% to 46.27% - Nutrivant Plus Tomato - 1%).

Figure 2: Foliar fertilizers influence on tomato in solar (Izmir cultivar) irigation by dripping

On tomatoes cultivated in solar (Izmir cultivar), in Table 5 reveal the influence of foliar fertilization on the assimilating pigment content in fresh leaves on solar tomatoes, harvested on 10 days after foliar application of the last treatment. Thus, by foliar fertilization

increases both of each part of assimilation pigment content, and the total content on assimilatory pigments (from 38.23% - Accele-GRO-M - 0.1% to 47.11% - Nutrivant Plus Tomato - 1%).

In terms of productive efficiency of fertilizers tested were achieved increases production, statistically (Fig. 2, Table 6), very significant, ranging between 32.11% (Accele-GRO-M - 0.1%) and 42.84% (Nutrivant Plus Tomato -1%). Energy production increases to 11,174 Mcal/ha (Control) to 15,962 Mcal/ha by foliar fertilization with Tomato-Nutrivant Plus 1%.

Energy balance (net energy gain) increases very significantly with values ranging between 21.96% (Accele-GRO-M - 0.1%) and 31.86% (Nutrivant Plus Tomato-1%).

Table 4

The efficiency of foliar fertilization on tomato photosynthesis in field (Izmir cultivar)

Variants	a Clorophyll				b Clorophyll				Carotene				Total pigments (mg/g s.pr)			
	mg/g	dif	%	sm	mg/g	dif	%	sm	mg/g	dif	%	sm	mg/g	dif	%	sm
Control , sprinkled with water	0.7141	-	100	-	0.5004	-	100	-	0.4172	-	100	-	1.6317	-	100	-
Accele-GRO-M – 0,1%	0.9653	0.2512	135.18	xxx	0.6858	0.1854	137.06	xxx	0.5685	0.1513	136.27	xxx	2.2196	0.5879	136.02	xxx
Accele-GRO-M – 0,3%	0.9914	0.2773	138.84	xxx	0.7035	0.2031	140.60	xxx	0.5822	0.1650	139.55	xxx	2.2771	0.6454	139.55	xxx
Nutrivant Plus Tomato – 1%	1.0392	0.3251	145.53	xxx	0.7371	0.2367	147.31	xxx	0.6104	0.1932	146.32	xxx	2.3867	0.7550	146.27	xxx
Fertel F – 1%	1.0088	0.2947	141.27	xxx	0.7162	0.2158	143.13	xxx	0.5927	0.1755	142.08	xxx	2.3177	0.6860	142.04	xxx

DL5% -0.1116mg/g s.pr **DL5% -0.0842 mg/g s.pr.** **DL5% -0.0624 mg/g s.pr** **DL5% -0.2335 mg/g s.pr.**
DL 1% -0.1707mg/g s.pr **DL 1% -0.1318 mg/g s.pr** **DL 1% -0.0816 mg/g s.pr** **DL 1% -0.3169 mg/g s.pr**
DL 0.1% -0.2035mg/g s.pr **DL 0.1% -0.1604 mg/g s.pr** **DL 0.1% -0.1352 mg/g s.pr** **DL 0.1% -0.4671 mg /g.s.pr**

Table 5

The efficiency of foliar fertilization on tomato photosynthesis in solar, irrigation by dripping (Izmir cultivar)

Variants	a Clorophyll				b Clorophyll				Carotene				Total pigments (mg/g s.pr)			
	mg/g	dif	%	sem	mg/g	dif	%	sm	mg/g	dif	%	sm	mg/g	dif	%	sm
Control , sprinkled with water	0.8574	-	100	-	0.6317	-	100	-	0.5043	-	100	-	1.9934	-	100	-
Accele-GRO-M – 0,1%	1.1784	0.3210	137.44	xxx	0.8781	0.2464	139.01	xxx	0.6991	0.1948	138.63	xxx	2.7556	0.7622	138.23	xxx
Accele-GRO-M – 0,3%	1.1918	0.3344	139.01	xxx	0.8922	0.2605	141.25	xxx	0.7077	0.2034	140.34	xxx	2.7917	0.7983	140.04	xxx
Nutrivant Plus Tomato – 1%	1.2553	0.3979	146.41	xxx	0.9357	0.3040	148.13	xxx	0.7416	0.2373	147.07	xxx	2.9326	0.9392	147.11	xxx
Fertel F – 1%	1.2291	0.3717	143.36	xxx	0.9195	0.2878	145.56	xxx	0.7302	0.7302	144.81	xxx	2.8788	0.8854	144.41	xxx

DL5% -0.1204 mg/g s.pr **DL5% -0.1071 mg/g s.pr.** **DL5% -0.0813 mg/g s.pr** **DL5% -0.3405 mg/g s.pr.**
DL 1% -0.1958 mg/g s.pr **DL 1% -0.1584 mg/g s.pr** **DL 1% -0.1349 mg/g s.pr** **DL 1% -0.4813 mg/g s.pr**
DL 0.1% -0.2547 mg/g s.pr **DL 0.1% -0.2019 mg/g s.pr** **DL 0.1% -0.1658 mg/g s.pr** **DL 0.1% -0.6826 mg /g.s.pr**

Foliar fertilization positively affects the average weight of fruit per plant (382 g - Accele-GRO-M - 0.1% respectively in case of Nutrivant Plus Tomato - 1% fertilizer - 493 grams), vitamin C content (13.76 mg/100 g f.s. - Control and 16.81 mg/100 g f.s. - Accele-

GRO-M - 0.3%) and percentage of first quality fruits (from 44% - Control up to 65% - Nutrivant Plus Tomato - 1%) (Table 7).

Table 6

Energy and productive efficiency on tomato fertilization in solar, irrigation by dripping (Izmir cultivar)

Variants	Average prod. (kg/ha)	Productive efficiency (kg/ha)			Energy efficiency (Mcal/ha)					
		Dif.	%	Smn.	OUTPUT	INPUT	Bilanț	dif	%	Smn.
Control , sprinkled with water	41387	-	100	-	11174	3911	7236	-	100	-
Accele-GRO-M – 0,1%	54676	13289	132.11	xxx	14763	5905	8858	1595	121.96	xxx
Accele-GRO-M – 0,3%	55636	14249	134.43	xxx	15022	6009	9013	1750	124.09	xxx
Nutrivant Plus Tomato – 1%	59117	17730	142.84	xxx	15962	6385	9577	2314	131.86	xxx
Fertel F – 1%	56899	15512	137.48	xxx	15363	6145	9218	1955	126.91	xxx

DL 5% - 5761 kg/ha **DL 5% - 623 Mcal/ha**
DL 1% - 8845 kg/ha **DL 1% - 758 Mcal/ha**
DL 0.1% - 11354 kg/ha **DL 0.1% - 1315 Mcal/ha**

Table 7

Foliar fertilizers influence on productivity and quality indices in solar on tomato, irrigation by dripping (Izmir cultivar)

Variants	Average weight on fruits / plant				C Vitamin (mg/100 g s. pr.)	Fruits quality (%)				
	Gramme	Dif.	%	Sm.		Cal. II	Cal. I	Dif.	%	Sm.
Control , sprinkled with water	985	-	100	-	13.76	56	44	-	100	-
Accele-GRO-M – 0,1%	1367	382	138.78	xxx	16.41	41	59	15	134.09	xxx
Accele-GRO-M – 0,3%	1391	406	141.22	xxx	16.81	39	61	17	138.31	xxx
Nutrivant Plus Tomato – 1%	1478	493	150.05	xxx	15.76	35	65	21	147.16	xxx
Fertel F – 1%	1422	437	144.36	xxx	15.03	38	62	18	140.76	xxx

DL 5% - 151 gramme **DL 5% - 5%**
DL 1% - 247 gramme **DL 1% - 7%**
DL 0.1% - 313 gramme **DL 0.1% - 11%**

CONCLUSIONS

Foliar fertilization is a complementary measure, unconventional and ecological by fertilization can improve the mineral nutrition and plant tissues which can created, of course, a nutritional balance that makes the plants to withstand stress conditions and also to ensure satisfactory yields;

The foliar fertilizers used to tomato, Izmir cultivar, during vegetation plants, provide significant production increases statistically both in solar and in field, compared with control unfertilized.

The foliar fertilization increases both of each of assimilation pigment content in part, and the total assimilatory pigments content (from 38.23% - Accele-GRO-M - 0.1% to 47.11% - Nutrivant Plus Tomato - 1% for tomatoes grown in solar and at 36.02% - Accele – GRO - M - 0.1% to 46.27% Nutrivant Plus Tomato - 1% for grown tomatoes in the field);

It has been shown, in particular, the product Nutrivant Plus Tomato - 1% foliar applied who made the most significant production increases and energy balance, but as we infer from the name is a product designed especially tomato crop;

Foliar fertilization positively affects the average weight of fruit per plant (growth - 30.34% Accele-GRO-M - 0.1% respectivelly 47.52% and Nutrivant Plus Tomato-1%), vitamin C content (12.84 mg/100 g f.s. - Control variant and 17.04 mg/100 g f.s. - Nutrivant Plus Tomato -1%) and percentage of first quality fruits (to 41% - Control variant up to 57% -

Nutrivant Plus Tomato - 1%) for field grown tomatoes;

Foliar fertilization positively affects the average weight of fruit per plant (382 g - Accele-GRO-M - 0.1% respectively in case of Nutrivant Plus Tomato - 1% fertilizer - 493 grams), vitamin C content (13.76 mg/100 g f.s. - Control and 16.81 mg/100 g f.s. - Accele-GRO-M - 0.3%) and percentage of first quality fruits (from 44% - Control up to 65% - Nutrivant Plus Tomato - 1%) in the case of tomatoes grown in the solarium.

BIBLIOGRAFY

1. ANTON IULIA, 2010, Optimizarea regimului elementelor nutritive la culturile din sere, Ed. Sitech, Craiova.
2. ANTON IULIA, 2010, Utilizarea îngrăşămintelor lichide în spaţii protejate în vederea optimizării regimului elementelor nutritive în sistemul sol – plantă la tomate şi ardei, Ed. Sitech, Craiova.
3. ANTON IULIA, A. DORNEANU, D. DANA, G. BIREESCU, L. ILIE, V. COTEŢ, I. OPRICĂ, D. MIHALACHE, A. GRIGORE, 2009. Research on ecological protection effect on the environment ensured by fertilization with new range of liquid fertilizers. Scientific Papers, Series A, LII, Agronomy, Bucharest.
4. ANTON IULIA, A. DORNEANU, P. NICULIŢĂ, D. DANA, G. BIREESCU, I. OPRICĂ, 2008. Results regarding the effects of Fertec fertilizers on tomatoes grown in glasshouse of S.C. SERE S.A., Codlea. Lucr. Şt., seria Agronomie, vol. 51, Ed. Ion Ionescu de la Brad, Iaşi.
5. BURZO I., ELENA DELIAN, AURELIA DOBRESCU, VIORICA VOICAN, LILIANA BĂDULESCU, 2004. Fiziologia plantelor de cultură. Vol. I, Procesele fiziologice din plantele de cultură. Ed. Ceres, Bucureşti.
6. CIOROIANU T., C. SÎRBU, M. DUMITRU, A. DORNEANU, D. ŞTEFĂNESCU, 2009. Îngrăşăminte neconvenţionale - Fertilizanţi lichizi. Ed. EstFalia.
7. DANIELA DANA, DANIELA ŞTEFANESCU, MARIA SOARE, IULIA ANTON, IOANA OPRICA, CARMEN SARBU, 2007. Cercetari preliminare privind efectul fertilizarii cu diferite doze de azot si ingrasaminte foliare asupra compozitiei chimice a plantelor de floarea soarelui. Lucrarile Simpozionului International: Restaurarea Fertilitatii Solurilor prin Diferite Sisteme de Fertilizare in Agricultura Durabila, Timisoara (pp. 367-375).
8. DANIELA DANA, VERONICA GĂINĂ, 2006, Fertilizarea foliară un mijloc eficient de prevenire şi combatere a dereglărilor de nutriţie cu micronutrienţi la cultura de porumb şi floarea soarelui. Ed. Cartea Universitară.
9. DORNEANU A., M. DUMITRU, IULIA ANTON, 2009, Foliar fertilization – a complementary tehnology of high efficiency for improving plant nutrition in the sustainable agriculture, The IVth Congress of the Academy of Romanian Scientists "Quality of Life", Timişoara, Romania.
10. EL FOULY M.M., 2002. Quality of foliar fertilizers. ISHS Acta Horticulturae 594: International Symposium on Foliar Nutrition of Perennial Fruit Plants.
11. LACATUS VICTOR, MARCEL COSTACHE, GABRIELA LUPU, 2008, Tomatele – Cultivarea în câmp, Ed. Ceres.
12. MARSCHNER H., 1995. Mineral nutrition of higher plants. Londra.
13. MENGEL K., 2002. Alternative or complementary role of foliar supply in mineral nutrition. ISHS Acta Horticulturae 594: International Symposium on Foliar Nutrition of Perennial Fruit Plants.