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RESEARCH ON BIOCOMPOSITE COMPOST INFLUENCE ON THE DEVELOPMENT OF HYBRID TOMATO SEEDLINGS "SYMPATHIE" F1 (FAMILY *SOLANACEAE*)

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Abstract

Biodegradable composting materials production is growing because of the environmental protection requirements which are becoming more and more restrictive regarding the plastics obtained from petroleum resources. Safety requirements must be met if the compost product is designed and used for agriculture, so far, the harmful effects of solid waste was estimated based mainly on its chemical composition. Phytotoxicity is described as an intoxication of living plants when certain substances which are present in the environment, are accumulated in plant tissue. Plant material analyzed was the hybrid tomato seedlings "SYMPATHIE" F1 (family Solanaceae), resulting from seed germination in greenhouse multiplier conditions.Were tested two types of compost: compost Control: only biowaste and test compost: biowaste + composite (10% PLA / Ecoflex (50/50)-Rettenmaier15%) in three experimental series, representing three proportions of mixtures S1 (25%), S2 (50%) and S3 (75%).The behavior of seedlings in various mixtures of compost before transplantation was considered. Different components of mixtures and experimental variant blends themselves were analyzed to see the content of nutrients, in soluble forms which could be available to plants during the vegetation.After two months of agrochemical analyses performed weekly on tomato seedlings, the results showed that the cultivated version of the compost sample P 25% (25% compost from V2-variant and 75% Profesional substrate of brown peat and dark peat), recorded high supply of N (53,20ppm), P (307,80 ppm) and K (5600 ppm) which will be used for transplanting in the field or greenhouse lower consumption of nutrients for plant growth and development.The findings obtained from experimental samples were compared with values recorded in tomato seedlings that were grown in parallel only in Professional Substrate mixture of peat and peat-dark brown 75% 25%, as control.

Key words**:** *biocomposite, compost, phytotoxicity, tomato seedlings*

INTRODUCTION

Compost has a high content of organic matter and helps to recover the intensive properties of the soil which were lost or damaged during use. Although compost is not considered a fertilizer it contains nutrients that could enhance plant growth. When used in combination with fertilizers, compost acts as a plant fertilizer that provides nutrients needed for a longer period than in the case of the application of fertilizers alone [1, 2].

Materials used in obtaining PLA based Biocomposites that are rich in carbon, are usually dried material, e.g. sawdust, cardboard, dried leaves, straw, branches and other woody or fibrous materials that are slowly disintegrated.

Mineral nutrition of tomato has some peculiarities that must be taken after fertilization. Thus, the specific consumption varies depending on the culture system, variety, production, supply degree of soil minerals [3].

MATERIAL AND METHOD

In preparing the test solution to determine the effect of substrate on growth and development of tomato seedlings from ”SYMPATHIE”F1 hybrid (*Solanaceae* family*)*, the following were taken into account: biological features of the hybrid analysis and the components of the biocomposite versions.

The compost samples were provided by OWS beneficiary.

Simpathie F1 is a tomato hybrid with undetermined growth, suitable for fresh consumption. The hybrid is very adaptable in various cultivation conditions due to excellent resistance to a range of diseases. Also, it has good resistance to storage and clusters are uniform and vigorous.

Tomatoes seedlings used for initiation of the experiment were obtained previously by seeding and sub-cultivating procedure, and when they reached the height of 5 cm and the second leaf grew out of the soil, they were transferred in vegetation pots with a diameter of 7 cm (Fig. 1).

Fig. 1. The tomato seedlings ”SYMPATHIE” F1 when before they were transferred in vegetation pots with a diameter of 7cm, on March 12, 2012

The experiments were performed between March 12 – April 27, 2012 for tomato plants ”SYMPATHIE” F1 in three experimental series, representing three mixture proportions 25% (S1), 50% (S2) and 75% (S3) from work versions as explained in Table 1.

The Control substrate used was 100% peat KAKKILÄ (Finland) DSM 110 (Dark Seed Mix) that contains: “starter” NPK fertilizers 14-16-18+mE, pH=5.5-5.9.

For every experimental series (S1, S2 and S3) of the two compost versions (Version 1-Control compost and Version 2-Test compost) ten seedlings for each sample (one vegetation pot = one repetition per sample), one seedling per pot, for all the six samples (V1-V6) were provided.

Further results of plant growth and development were compared with Control (MT) version represented by 100% KAKKILÄ DSM 110 peat substrate. These were also provided with ten seedlings, one seedling per vegetation pot.

Table 1. Definition of samples/ substrate versions used in the experiments

Biocomposite samples versions	Work samples	Sample
Version 1 Control compost (only biowaste at start)	V1 - C 25%	S1 (25% Control compost)+ (75%) KAKKILÄ DSM 110 substrate
	V2 - C 50%	S2 (50% Control compost)+ (50%) KAKKILÄ DSM 110 substrate
	V3 - C 75%	S3 (75% Control compost)+ (25%) KAKKILÄ DSM 110 substrate
Version 2 Test compost: Biowaste + 10% PLA/Ecoflex(50/50)-Rettenmaier15% at start	V4 - P 25%	S1 (25% Test compost)+(75%) KAKKILÄ DSM 110 substrate
	V5 - P 25%	S2 (50% Test compost)+(50%) KAKKILÄ DSM 110 substrate
	V6 - P 75%	S3 (75% Test compost)+(25%) KAKKILÄ DSM 110 substrate
Control	MT	100% KAKKILÄ DSM 110 peat substrate (0% Biocomposite samples versions)

For each 7 cm diameter vegetation pot were used 20 grams/ each pot of mixture in the set proportions for the three experimental series: S1, S2 and S3 for both compost versions, noting that the control used each time was KAKKILÄ peat (Finland) DSM 110 (Dark Seed Mix).

RESULTS AND DISCUSSIONS

During vegetation period, the plants’ height was measured weekly in and the plants’ shoots were numbered. Also agrochemical analyses were performed weekly on the substrates and plants, to determine the status of the fertilizer supply.

For testing the seedlings behavior in different compost mixtures , right before transplantation both experimental versions mixture

components and the peat mixtures themselves were analyzed, to determine the nutritive elements content, in soluble forms that are available to plants during vegetation period. The results are presented in Table 2.

After transplantation, the tomatoes were left for two weeks for acclimatization (Fig. 2) and then collected weekly for analysis. Thus, the first analysis was made on April 10, 2012, when some biometric measurements of the plant height and weight, and agrochemical analyses to the substrate and plants were made (Fig. 3).

Fig. 2. Picture from March 30, 2012 (after ten days from the start of the experiment) - culture in the greenhouse multiplier (UASVM Bucharest)

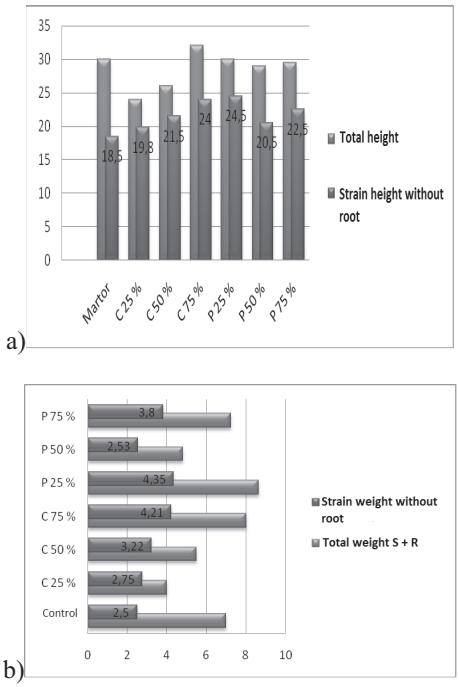

Fig. 3. Results of tomato seedlings "SYMPATHIE" F1 biometric measurements on April 10, 2012 in experimental versions: a.) height variation; b.) weight variation

In the same time with the biometric measurements on April 10, 2012, agrochemical analyses were performed for the experimental versions substrates (Table 3). Analyzed tomato seedlings presented high quantities of N, P and K which created the conditions to obtain a high supply of plant and achieve high yields while transplanting in the field or greenhouse (Table 4).

Table 2. The analysis of the components and substrate mixtures on March 22, 2012

Version code	Version name	pH	Soluble salts %	Concentration, ppm			
				N-NH4	N-NO3	P-PO4	K
1.P	**Testing compost**	7.3	1.450	68.832	163.400	58.050	320
2.T	**Peat**	7.0	0.375	27.724	147.250	109.687	50
3.Ct	**Control compost**	7.1	1.736	59.272	427.500	106.312	480
4.V1	**C 25%**	7.1	0.375	27.724	118.750	38.475	50
5.V2	**C 50%**	7.1	0.346	9.560	121.600	24.050	105
6.V3	**C 75%**	7.0	0.332	8.604	115.900	26.075	275
7.V4	**P 25%**	6.9	0.245	6.692	68.400	25.312	245
8.V5	**P 50%**	7.0	0.375	16.252	77.900	25.312	355
9.V6	**P 75%**	6.9	0.231	11.472	94.050	14.175	160

* P = test compost
C = compost biowaste, control

Table 3. Tomato soil analysis on April 10, 2012

Version code	Version name	pH	Soluble salts %	Concentration, ppm			
				N-NH4	N-NO3	P-PO4	K
1.Ct	**Control**	6.9	0.2601	17.208	36.100	8.438	70
2.V1	**C 25 %**	7.0	0.2601	25.812	33.250	15.863	290
3.V2	**C 50 %**	7.3	0.2745	25.812	12.428	16.538	330
4.V3	**C 75 %**	7.4	0.3381	24.856	24.700	12.150	400
5.V4	**P 25 %**	7.2	0.3265	28.680	24.700	27.675	360
7.V5	**P 50 %**	7.2	0.4190	29.636	36.100	14.175	465
8.V6	**P 75 %**	7.2	0.3468	32.504	48.450	24.638	345

Table 4. Tomato plant analysis on April 10, 2012

Version code	Version name	Concentration, ppm		
		N-NO3	P-PO4	K
1.Ct	**Control**	216.60	70.20	4960
2.V1	**C 25 %**	425.60	303.75	4420
3.V2	**C 50 %**	273.60	337.50	4540
4.V3	**C 75 %**	277.40	324.00	5400
5.V4	**P 25 %**	395.20	375.30	5800
7.V5	**P 50 %**	406.60	382.05	4100
8.V6	**P 75 %**	444.60	441.45	5100

The second time of analysis, on April 24, 2012, biometric measurements on plant height and on tomato seedlings weight were developed; the results are presented in Fig. 4.

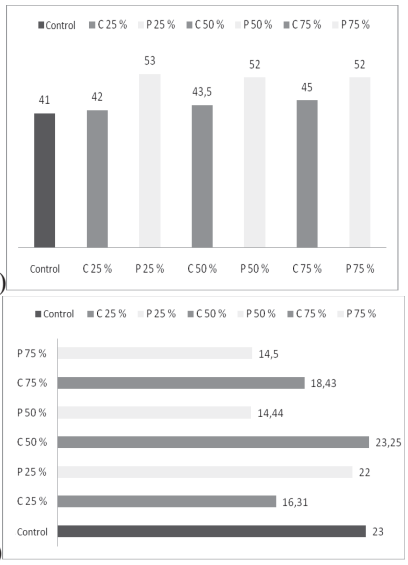

Fig. 4. The increase in tomato seedlings ”SYMPATHIE” F1 biometric measurements evaluation on April 24, 2012 in experimental versions: a.) height variation; b.) weight variation

On April 24, 2012 agrochemical analyses for experimental versions substrates and tomato seedlings were performed (Table 5 and Table 6). The potassium appeared to be the only element that increased significantly, almost doubled in the second time of analysis.

In Fig. 5, tomatoes seedlings are depicted after 40 days from the start of the experiments.

Fig. 5. Pictures from April 20, 2012 (after 40 days from the start of the experiments) -cultivated in multiplier greenhouse (UASVM Bucharest)

Table 5. Tomato soil analysis on April 24, 2012

Version code	Version name	pH	Soluble salts %	Concentration, ppm			
				N-NH4	N-NO3	P-PO4	K
1.Ct	**Control**	6.1	0.2312	9.560	5.70	4.388	920
2.V1	**C 25 %**	5.9	0.3323	10.516	13.30	16.538	1175
3.V2	**C 50 %**	5.8	0.3843	17.208	15.20	9.788	1025
4.V3	**C 75 %**	6.0	0.4046	21.032	16.15	9.450	1350
5.V4	**P 25 %**	5.9	0.4190	21.988	15.20	15.863	970
7.V5	**P 50 %**	6.0	0.3034	19.120	23.75	17.550	1175
8.V6	**P 75 %**	5.9	0.3612	19.120	18.05	12.825	1050

Table 6. Tomato plant analysis on April 24, 2012

Version code	Version name	Concentration, ppm		
		N-NO3	P-PO4	K
1.Ct	**Control**	26.60	438.75	160
2.V1	**C 25 %**	38.00	513.00	860
3.V2	**C 50 %**	68.40	459.00	980
4.V3	**C 75 %**	34.20	355.05	1540
5.V4	**P 25 %**	26.60	533.25	920
7.V5	**P 50 %**	53.20	625.05	860
8.V6	**P 75 %**	26.60	560.25	1024

The plant analysis from the experimental versions showed a good supply of nutritive elements assured by the transplantation high quantity productions.

The last time of analysis was on May 3, 2012. The tomato seedlings in experimental versions showed similar growth rates in terms of heights (Fig. 6).

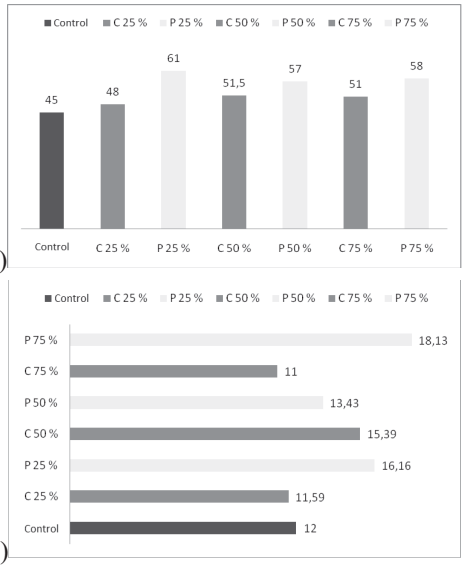

Fig. 6. The increase in tomato seedlings ”SYMPATHIE” F1 biometric measurements evaluated on May 3, 2012 in experimental versions: a.) height variation; b.) weight variation

Generally, the testing compost versions recorded higher accumulations of fresh substance comparative with control compost versions.

Tomato seedlings weight (Fig. 6 b) oscillated between 11g in version C75% to 18.13g in version P75%. In general, the tomato seedlings who grew in testing compost versions recorded higher accumulations of fresh substance comparative with the tomato seedlings that grew in control compost versions.

Agrochemical analysis of the substrate (Table 7) from the experimental versions showed that the pH increased oscillating between 6.4 and 6.7, the soluble salts content remained high characterizing weak saline substrates, the nitrogen supply was high, and the phosphorus content decreased characterizing low supply .

The statistical interpretation of the relation between the height of tomato seedlings and the nitrogen content of the substrate, based on mathematical regression, showed a statistically significant linear correlation with the coefficient R=0.90332 (Fig. 7).

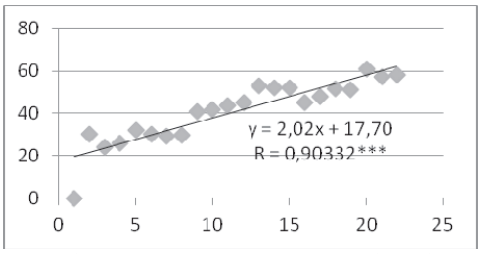

Fig. 7. The correlation between tomato seedlings height and the nitrogen content (N) of the substrate

Also, between the N content from the substrate and the N content from the tomato seedlings there is a statistically significant correlation, with the coefficient R = 0.77588 (Fig. 8).

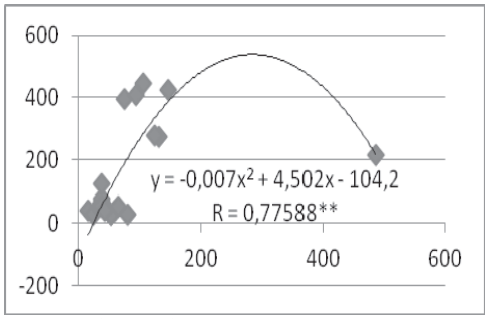

Fig. 8. The correlation between N content from the substrate and N content from the tomato seedlings

Table 7. Tomato soil analysis on May 3, 2012

No.	Version	pH	Soluble salts %	Concentration, ppm N-NH4	N-NO3	P-PO4	K
1.Ct	Control	6.5	0.3179	4.780	7.6	3.713	20
2.V1	C 25 %	6.6	0.7225	21.032	20.9	5.738	320
3.V2	C 50 %	6.7	0.4624	17.208	20.9	5.400	95
4.V3	C 75 %	6.6	0.4335	18.164	14.25	7.763	340
5.V4	P 25 %	6.7	0.5491	19.120	15.2	9.450	190
7.V5	P 50 %	6.5	0.4335	30.592	29.45	8.100	260
8.V6	P 75 %	6.4	0.6647	27.724	18.05	8.775	190

CONCLUSIONS

The testing compost versions recorded higher accumulations of fresh substance compared with control versions;

Agrochemical analyses of the substrates from experimental versions showed that the pH initially decreased at about 5.8 – 6.1 and then increased oscillating between 6.4 and 6.7;

Soluble salts content from the substrates experimented on remained high characterizing weak saline substrates;

Nitrogen supply of the substrates was high, phosphorus content decreased during vegetation characterizing low supplied substrates on this element, while potassium from the substrates was very high because of the slow release of this element from the compost;

Tomato seedlings agrochemical analyses showed that these had a high supply in N, P and K which would in turn provide a lower consumption of nutrients for plant growth and development when transplanting in the field or greenhouse;

The statistical interpretation by analysis of variance on seedling height showed that the versions made with test compost (P25%, P50%, P75%) had significant results and in the matter of plant weight, all versions had statistically insignificant results;

Taking into account the composition of the six experimental samples (V1-V6), it is a clear conclusion that as general tendency, the phytotoxicity is lower for the sample based on PLA Biocomposite (Biowaste + 10% PLA/Ecoflex(50/50)-Rettenmaier15% at start =V4-V6) in comparison with the Control compost Biocomposite (only biowaste at start =V1-V3) and control KAKKILÄ peat (Finland) DSM 110.

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