THE EFFECT OF *CHAETOMIUM GLOBOSUM* AND ORGANIC FERTILIZER ON THE SWEET PEPPER VARIETIES GROWTH AND YIELD UNDER THE GREENHOUSE CONDITIONS

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Abstract

This experiment was conducted at horticulture college (USAMV Bucharest) during the summer season of the year 2017 to investigate the growth and yield of sweet pepper varieties (Dinamica f1, Abadia f1 and Abadia f1-grafted on emperador) planted under the greenhouse as influenced by Dix 10 n (organic fertilizer) with dose (300 g/m2 dix 10n) and soil contaminated with *Chaetomium globosum* fungus. The results of the experiment demonstrated that the highest plant height between the varieties were represented by Dinamica recorded 69.66cm while the maximum plant height between the interaction treatments recorded with (Dinamica + (D+CG), Dinamica + CG and Abadia G+ CG evaluated (89.66, 87.66, 84.00 cm) respectively. While the highest percentage of aerial plant dry matter represented by the interaction treatments of Dinamica + (D + CG) and Abadia G + (D + CG) which reached to (18.56 and 18.53 %) respectively. While the minimum effect for percentage of root dry matter obtained (15.20 and 16.20 %) for control treatment of (Abadia and Abadia G) respectively. The highest yield of plant (Dinamica + (D + CG), Abadia G (D + CG) and Abadia (D + CG)) were recorded lowest yield per plant were (1367.66, 1363.00 and 1325.66 g) respectively. The highest chlorophyll content in leaves were (135.30 and 117.53 µmol m-2) in Abadia G (D + CG) and Abadia G + CG respectively. The minimum photosynthesis value was 7.36 µmol m-2 s-1 in Abadia G (D + CG). The maximum of highest N-NO_3 was in Dinamica + (D+CG) treatment which reached to 90.13 ppm, while the highest PO_4 level was observed in Abadia + D treatment which recorded 198.87 ppm and the highest level of K was in Abadia G + CG which reached to 4066.66 ppm.

Key words: *Chaetomium globosum*, fertilizer, greenhouse, plant growth, sweet pepper varieties

Sweet pepper (*Capsicum annuum L*) is a member of the solanaceous fruity vegetables group (El-Bassiony *et al*, 2010). Pepper is grown as an annual crop because of its sensitivity to frost and it is in fact an herbaceous perennial and a good survivor and gave a yield for several years in tropical climates (Vasile *et al*, 2010). The nutritional significance of the pepper crop is due to its high vitamin C content which reached to six times as much vitamin C as orange (Bosland and Votava, 2007).

Pepper is a very rich source of vitamin A, which consider as opulent source of beta-carotene which turns into vitamin A and work on protects the skin and body tissues, the green bell pepper can supply up to 8 percent of the recommended daily allowance of Vitamin A, 180 percent of Vitamin C, 2 percent of calcium and 2 percent of iron (Kelley and Boyhan, 2009). Sweet peppers *Capsicum annuum L.* (*C. annuum*) are an excellent source of phenolic compounds, which are important antioxidant components that may reduce the risk of diseases (Yazdizadeh Shotorbani *et al*, 2013).

Chaetomium species are usually found in soil and organic fertilizer. *Chaetomium* is one of the largest genera of saprobic ascomycetes with more than 300 species worldwide (Soytong and Quimio, 1989). *Chaetomium globosum* is a potential bio control agent against various seed and soil borne pathogens. Plant pathogens are the main threat for profitable agricultural productivity. In the modern, intensified agriculture, the efficient management of plant diseases is essential. At present the most reliable means of doing this is by the use of fungicides. Fungicides are the toxic substances which either kill or check the growth of the fungi. During the last two decades, fungicide research has produced a diverse range of fungicidal products with novel modes of action which had a significant impact on plant disease control. The

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need for new and innovative fungicides is driven, among other factors, by resistance management, regulatory hurdles, and increasing customer expectations. Compounds having a novel mode of action are of course of special interest, since they play a key role in resistance management strategies, but equally important are new fungicides with enhanced characteristics such as systemicity, curativity, and longevity of disease control. The technical feature of new generation fungicides is to target specific action and to be safer to non-target sites. Over the past few years, however, several truly novel compounds have been launched commercially and have reached an advanced stage of development, which include with effects on respiration, cell membrane components, protein synthesis, signal transduction and cell mitosis. Many of the important plant diseases, which were not controlled satisfactorily by the previous traditional fungicides, can now be well managed by the new compounds which are mostly systemic in nature. In view the risk of resistance development with most of the systemic, site specific compounds, there is a need to develop more classes of fungicide with novel target sites (Nadi *et al,* 2017). Currently, Chemical fungicides are highly effective and convenient to use but they are a potential threat for the environment. Therefore, the use of biocontrol agents for the management of plant pathogens is considered as a safer and sustainable strategy for safe and profitable agricultural productivity. Many experiments and studies revealed by various researchers *C. globosum* used as plant growth promoter and resulted into high yield of crops in field conditions. *C. globosum* produces pectinolytic enzymes polygalacturonate transeliminase (PGTE), pectin trans-eliminase (PTE), viz., polygalacturonase (PG), pectin methyl esterase (PME), protopectinase (PP), xylanase and cellulolytic (C and C) 1 xenzymes and various biologically active substances, such as chaetoglobosin A, *Chaetomium* B, C, D, Q, R, T, chaetomin, chaetocin, chaetochalasin A, chaetoviridins A and C (Ashwini, 2019). Bio-control technology of plant diseases has successfully been demonstrated, either completely or partially, when integrated with other control measures for appropriate disease management. Biological products are useful, not only for the protection against plant diseases, but can also be used for curative effects of plant diseases, and also promote plant growth (Soytong *et al,* 2001). The aim of experiment was to determine nutritional quality of DIX 10N (organic fertilizer) and *C. globosum* to produce highest parameters growth and yield in sweet pepper varieties.

MATERIAL AND METHOD

This experiment was conducted at Horticulture Faculty (USAMV) in Bucharest during the summer season of the year 2017 to investigate the effect of providing DIX 10N (D) (organic fertilizer) at rate (300 g/m2) and soil contaminated with *C. globosum* at rate (1% fungus per water) on growth and yield of sweet pepper varieties: Dinamica F1, Abadia F1 (non-grafted) and Abadia grafted (G) on emperador variety (tomato rootstock). All the seedlings bought from the local market and planted in 14-04-2017 under the greenhouse. The distance 0.5 m between plants in the same row and 0.8 m between rows, the Dix10N fertilizer was provided to the soil before planting and the contamination with *C. globosum* done by injected to the root system after planting by a week.

The experimental soil was sandy loam in texture with pH of 6.55, E.C of 0.180 dSm^{-1}. The available $N\text{-}NO_3$ of 34.33 ppm, $N\text{-}NH_4$ of 112.54 ppm, phosphorus and potassium contents were 21.0 ppm and 177.72 ppm respectively. Randomized complete block design (factorial) consisted of 3 randomized blocks with 4 treatments of bio fertilizer (Dix10 N, *C. globosum* (CG), Dix10 N (N) + *C. globosum* (N+CG) and control (C)) and 3 cultivars (Dinamica, Abadia and Abadia G). Each treatment consisted of 3 replicates and each replicates cultivated by 5 plants. Plants were irrigated using drip irrigation when needed depending on the moisture status of the soil and requirement of plants, also plants were kept free from weeds, insects, and diseases using standard growing management. The results were taken after 9 weeks for each plant harvested, the data were subjected to analysis of variance (ANOVA) the statistical systems (SAS 6.12) package. Comparison of multiple means was performed using the least significant difference (LSD) test at the 5% the following growth and yield parameters were measured:

Plant height (cm): Measured the length of the plant from the soil surface up to the highest point in the main stem every week.

2. Total yield (g): done by collect the fruits from each replicate then weight them and divided to get the average of plant yield.

3. Photosynthesis (µmol m^{-2} s^{-1}): estimated after 4 weeks by using a portable device LCi (ADC BioScientific Ltd.).

4. Plant and Root dry matter %: At the end of growing season, 3 plants from each replicate selected to measure plant dry weight and root dry weight. The samples kept in oven for 24 hours in 105˚C. After 24 hours the samples weighted with a digital scale then obtained the percentage of (Plant and Root dry matter %).

5. Chlorophyll content in leaves (µmol m^{-2}): determinate by using Chlorophyll meter device (CCM-200 PLUS).

6. N-NO_3 leaf content according to Katrina (2001)
7. (P-PO_4 and KO_4) leaf content according to (Ministerul Agriculturii Si Indutiei Almentare Academia De Stilnte Agricole Sisilvice, 1981).

RESULTS AND DISCUSSIONS

All treatments tended to increase the yield and vegetative growth parameters of sweet pepper compared with the control. The unfertilized plants produced the poorest plants compared with other fertilizer treatments. In (*figure 1*), it's clearly showed difference in the growth pattern between the pepper varieties due to the effect of varieties and the application of Dix 10N and *C. globosum* which improved nutrition of the plants. The highest plant height between the varieties were represented by Dinamica recorded 69.66 cm while the maximum plant height between the interaction treatments recorded with (Dinamica + (D+CG), Dinamica + CG and Abadia G+ CG evaluated (89.66, 87.66, 84.00 cm) respectively.

Chaetomium spp. has been reported to increase plant growth parameters and yields of many kinds of plants. The natural products or fungal metabolites released from *Chaetomium spp.* also reported to increase plant growth, yield and induce plant immunity. It can be developed as a bio fertilizer to increase in plant growth and yield in several kind of economic plants (Song and Soytong, 2017). Also, this results agree with (Volkan and Hakan, 2018) found that plants of pepper height were slightly influenced by grafted. In addition to the effect of organic fertilizer Dix 10 N (D) contains a large percentage of organic elements that are essential for maintaining soil fertility, eases up the gradual absorption of the nutrients from the soil, improves soil structure and increases water retention capacity (Nicolae *et al*, 2014).

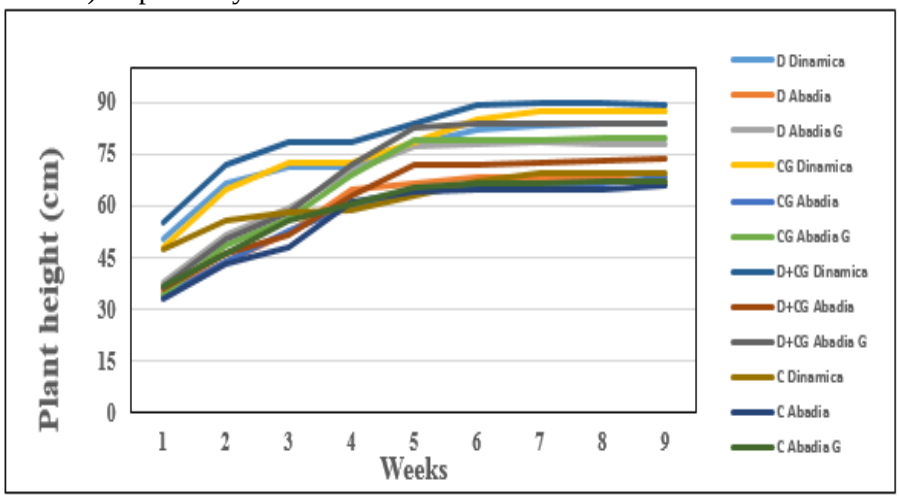

Figure 1 **The effect of varieties and the application of Dix 10N and *Chaetomium globosum* on pepper growth**

Effect the interaction between (D and *CG*) and varieties on some plant growth, yield parameters, chlorophyll and photosynthesis

Data in *table 1* showed significant effects of the interaction treatments between varieties and (D and CG). All the individual interaction treatments between the varieties and any of applications D or CG indicated differences in the degree of response between the individual interactions. However, the highest percentage of aerial plant dry matter represented by the interaction treatments of Dinamica + (D + CG) and Abadia G + (D + CG) which reached to (18.56 and 18.53 %) respectively.

While the minimum effect for percentage of root dry matter obtained (15.20 and 16.20 %) for control treatment of (Abadia and Abadia G) respectively. The highest yield of plant (Dinamica + (D + CG), Abadia G (D + CG) and Abadia (D + CG)) were recorded lowest yield per plant were (1367.66, 1363.00 and 1325.66 g) respectively. The highest chlorophyll content in leaves were (135.30 and 117.53 µmol m^{-2}) in Abadia G (D + CG) and Abadia G + CG respectively. The minimum photosynthesis value was 7.36 µmol m^{-2} s^{-1} in Abadia G (D + CG).

Table 1

Table 1 The effect varieties with D and CG on yield and some growth properties of sweet pepper

Treatments	Varieties	Plant dry matter%	Root dry matter %	Plant yield (g)	Chlorophyll µmol m^{-2}	Photosynthesis µmol m^{-2} s^{-1}
D	Dinamica	17.63	22.36	1288.66	107.70	6.40
	Abadia	16.36	20.73	1194.00	102.80	7.10
	Abadia G	18.06	21.96	1293.00	103.23	6.86
CG	Dinamica	15.66	20.93	1285.66	112.50	6.10
	Abadia	16.26	22.86	1181.00	104.33	6.06
	Abadia G	16.20	24.33	1235.33	117.53	6.13
D + CG	Dinamica	18.56	22.06	1367.66	114.73	6.90
	Abadia	17.40	22.96	1325.66	108.23	6.70
	Abadia G	18.53	24.90	1363.00	135.30	7.36
C	Dinamica	13.06	19.13	1178.33	75.46	5.36
	Abadia	14.80	15.20	1132.66	92.06	5.23
	Abadia G	13.06	16.20	1196.00	90.63	5.87
L.S.D		**1.25**	**1.09**	**22.41**	**2.17**	**1.19**

Effect the interaction between (D and T) and varieties on NPK concentration in leaves

The analysis showed in Table (2) superior concentration of NPK in pepper leaves with all combinations between varieties and (D + CG).

For the individual interactions between varieties and/or D and CG estimated that all varieties interactions with CG application recorded highest effect for NPK. The maximum of highest $N\text{-}NO_3$ was in Dinamica + (D+CG) treatment which reached to 90.13 ppm, while the highest PO_4 level was observed in Abadia + D treatment which recorded 198.87 ppm and the highest level of K was in Abadia G + CG which reached to 4066.66 ppm.

Table 2

The effect of D and *CG* on NPK content in leaves of sweet pepper varieties

Treatments	Varieties	$N\text{-}NO_3$ ppm	PO_4 ppm	K ppm
D	Dinamica	85.13	149.66	3973.33
	Abadia	61.33	198.87	3620.00
	Abadia G	77.40	156.33	3486.66
CG	Dinamica	77.10	144.33	3186.66
	Abadia	62.70	176.94	3351.66
	Abadia G	74.93	138.26	3260.00
D + CG	Dinamica	90.13	163.33	3826.66
	Abadia	83.03	188.00	3740.00
	Abadia G	74.26	189.00	4066.66
C	Dinamica	58.90	116.33	3320.00
	Abadia	46.86	107.96	2625.33
	Abadia G	63.63	136.85	2793.33
L.S.D		**10.69**	**15.35**	**68.52**

The maximum of highest growth characters may be due to the better physic-chemical properties of Dix 10N (D) which contains 10% N, 3% P_2O_5 and 3 K_2O and It is a good source

of organic matter 41% which would have improved the physic-chemical properties of soil. Although using organic fertilizers led to lower soil bulk density produced growth promoting hormone that causes better root network of plant and can improve plant growth development by providing better soil physical condition for root growth and development that causes higher root dry weight% this results agree with (Dynes, 2003). Generally, it has been reported that grafting promotes vegetative growth at different levels dependent on rootstock (Colla *et al*, 2008). Promoted vegetative growth (plant height) was explained by the vigorous root system of rootstocks, which are often capable of absorbing water and plant nutrients more efficiently than scion roots and serve as a good supplier of endogenous hormones (Cohen and Naor, 2002). In addition to the plants affected by the status of soil nutrients, especially N Therefore, the pepper crop is expected to benefit from N fertilizer application as the adequate supply would correct N deficiency and result in rapid vegetative growth, deep green colour and higher fruit yield. Brady and Weil (2002). Also the fungus that works on the readiness of the elements and make them soluble in facilitating the plant absorption, especially the element of phosphorus, nitrogen and potassium (Matrood, 2015).

CONCLUSIONS

Chemical fungicides are highly effective and convenient to use but they are a potential threat for the environment. Therefore, the use of biocontrol agents for the management of plant pathogens is considered as a safer and sustainable strategy for safe and profitable agricultural productivity. In order to reduce plant disease losses, it is necessary to devise strategies to overcome these problems. Plant diseases are the cause of a variety of microorganisms that include fungi, bacteria, viruses, viruses, and plant plasma. The largest number of plant diseases caused by fungi, and the most common and economical chemical tools for controlling fungal plant diseases are fungicides. The history of the use of chemical fungicides in agriculture began to combat plant diseases since the nineteenth century, when B. Prevost efficacy of copper for controlling seed-borne disease in wheat. Since then, fungicides have been used in agriculture to protect crops from losses from plant diseases and it is recognized as an essential component of crop protection programs. Sweet pepper is a member of the solanaceous fruity vegetables group. Pepper is grown as an annual crop because of its sensitivity to frost and it is in fact a herbaceous perennial and a good survivor and gave a yield for several years in tropical climates. The nutritional significance of the pepper crop is due to its high vitamin C content which reached to six times as much vitamin C as orange. *Chaetomium* species are usually found in soil and organic fertilizer. *Chaetomium* is one of the largest genera of saprobic ascomycetes with more than 300 species worldwide. *C. globosum* is a potential bio control agent against various seed and soil borne pathogens. Plant pathogens are the main threat for profitable agricultural productivity. The aim of experiment was to determine nutritional quality of DIX 10N (organic fertilizer) and *C. globosum* to produce highest parameters growth and yield in sweet pepper varieties. Our present study showed that some of plant growth parameters such as plant height, Total yield, Plant and Root dry, Chlorophyll content in leaves and photosynthesis and some plant metals are affected by the use of Dix N10 and *C. globosum* either together or alone. Also the impacts were diverse between sweet pepper varieties, but the most positively effect was the Dinamica with Dix N 10 or/and *C. globosum*.

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