Scientific Bulletin. Series F. Biotechnologies, Vol. XXVI, No. 2, 2022
ISSN 2285-1364, CD-ROM ISSN 2285-5521, ISSN Online 2285-1372, ISSN-L 2285-1364

EVALUATION OF THE IMPACT OF THE *Trichoderma* TREATMENT IN BUZĂU BELL PEPPER (*Capsicum annuum*) CULTURE 10

Cristian-Alexandru TOADER[1], Floarea BURNICHI [1], Dumitru-Mitel TOMA[1], Vasilica MANEA[1], Emilian MIREA[1], Mona Elena POPA[2]

[1]Vegetable Research and Development Station Buzău, Romania
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Biotechnology, 59 Mărăști Blvd., District 1, Bucharest, Romania

Coresponding author email: alecsx_kid@yahoo.com

Abstract

In the experimental field of the Buzău Vegetable Research and Development Station, research was carried out on the effect of Trichoderma T85, administered at planting, in granular form, for the culture of bell peppers, Buzău 10 variety, created by SCDL Buzău. In this regard, the growth and development of bell pepper plants, the Buzău 10 variety, the monitoring of the phytosanitary condition of the plants and the harmful and useful fauna from the soil were determined and monitored in dynamics. 5 experimental variants were set up in randomized blocks. This fungal inoculant was applied to V5 - three granules at planting. The obtained results confirm the data presented in the literature: Trichoderma prevents the growth of other pathogenic fungi, very widespread, such as: Alternaria, Botrytis, Colletotrichum, Fusarium, Phythophtora, Pytium, Sclerotinia, Xanthomonas. At the same time, this fertilizer is an environmentally friendly option because it does not pollute groundwater.

Key words: *Trichoderma, Capsicum annuum, fertilizer, pepper fruit production.*

INTRODUCTION

Trichoderma is often found in soil microflora of various ecosystems, such as agricultural fields, forests, wetland areas in all climatic zones. Root colonization by *Trichoderma* strains leads to root growth and nutrient uptake and utilization, increased production, and increased resistance to abiotic and biotic factors. Field crop productivity can increase up to 30% after treating seeds or soil with different *Trichoderma* species (Benitez T., Rincon A.M., Limon M.C., Codon A.C., 2004). The purpose of this study was to evaluate the effect of applying application and evaluation of the impact of the treatment on the fat pepper culture Buzău 10.

The main action of *Trichoderma* is the microbial antagonism that is usually manifested by various mechanisms of action such as: when considering the interactions of *Trichoderma* fungi with plants, it was found that these fungi have an advantageous effect on plants. Stimulation of plant growth and yield takes place thanks to this interaction and the advantageous effects are seen in the production of vitamins, the increased availability of biogenic elements (nitrogen, phosphorus), the mobilisation of nutrients from the soil and from organic matter, and the enhanced intensity of mineral uptake and transport.

Furthermore, *Trichoderma* fungi are capable of producing zeaxanthin and gibberellin, i.e. compounds accelerating seed germination. Many *Trichoderma* strains produce acids, e.g. gluconic, citric, and coumaric acids, causing the release of phosphorus ions and microelements, which subsequently become available to plants (Harman et al. 2004).

Trichoderma thus prevents the growth of other pathogenic fungi, very widespread, such as: *Alternaria, Armillaria, Botrytis, Colletotrichum, Fusarium, Phythophtora, Pytium, Rhizoctonia, Sclerotinia, Xanthomonas*, etc. It has an important activity of nutrition and phytostimulation and induces an increase in productivity.

In the southern part of Romania, more precisely in the Buzău vegetable basin, the pepper met favorable conditions for development and currently occupies a leading place among cultivated vegetables.

The strains were grown in Potato Dextrose Agar (PDA) plates and incubated for 10 days at 28°C to obtain abundant sporulation. Spore suspen-

sions of *Trichoderma* sp. were prepared by scraping the spores from cultures using 15 mL distiled water and after added Tween 80, 0.1% solution to reduce surface tension and facilitate spore release. The concentration of spore suspension was counted using haemocytometer and was adjusted to two concentration 107 spores/mL and 108 spores/mL.
Trichoderma strains (Td85 and Tal12) which have been used in this experiment were obtained from the collection at the Research and Development Institute for Plant Protection.

MATERIALS AND METHODS

Within Vegetable Research and Development Station Buzău, research was carried out on the influence of *Trichoderma* administered at planting, in cubes, for seedlings, on the bell pepper plants of the Buzau 10 variety.
The culture technology used was the culture technology specific to this species, adapted to the climatic conditions of 2019, in a conventional system.
In 2019 an experimental field of bell pepper was organized, in which the rules of experimental technique were applied in terms of regarding the size of the plot, the number of repetitions, the observations made, the necessary analyzes, the calculation of the results, their statistical interpretation.
The seeds were sown in alveolar paddles of 70 cubes, with a volume of 50 ml, in blond peat partially decomposed and with the addition of trace elements (Figure 1).
The arrangement of the experiment was in randomized blocks, with 5 variants and 4 repetition. Below we see the planting scheme of bell pepper Buzău 10 (Table 1).

Table 1. Planting scheme - bell peppers Buzău 10

V5R1	V2R2	V4R3	V1R4
V4R1	V1R2	V3R3	V5R4
V3R1	V5R2	V2R3	V4R4
V2R1	V4R2	V1R3	V3R4
V1R1	V3R2	V5R3	V2R4

The emergence period was between 11.04-24.04, and the percentage of rise ranged from 94.3-98.6%.

The application dose was 3 granules/cube, at the time of planting on 04.06.2019.

Figure 1. Peppermint seedling Buzău 10

The biological material used to establish the crop was the Buzau 10 bell pepper variety, created by Vegetable Research and Development Station Buzău.
Characterization of biological material:
- vigor medium;
- fruits average weight 90-120 g;
- shape trapezoidal;
- height 9 cm;
- diameter 6 cm;
- average fruit width 5.58;
- pulp thickness 6-7.5 mm;
- color at consumption maturity medium yellow to red;
- color at physiological maturity intense red with luster;
- maturation period early;
- number of lobes 3;
- tolerance high in VMT and potato virus Y (PVY);
- good tolerance to pathogens of economic importance;
- storage capacity very good;
- production potential 35-40 t/ha. (Catalog Buzău Vegetable Research and Development Station, July 2013).

It can be grown both in solariums and in the open field for fresh consumption and industrialization (Figure 2).

Figure 2. Detail fruit - bell peppers Buzău 10

Phytosanitary treatments were applied during the vegetation. Here we have the treatment scheme during the vegetation periods (Table 2).

Table 2. Treatment schema

The damage agent: Disease/harmful agents	The name of the product	Dose used
Phytophthora capsici, Thrips, Aphids, Spider	Dithane, Mavrik, Milbeknock	0.2%; 0.5%; 0.75%
Micoze, Spider, Caterpillar	Ortiva Top, Afirm, Envidor	1 l/he
Thrips, Aphids, White fly	Actara, Karate zeon	0.2 kg/he; 0.015%
Bacteriosis, Vascular disease, Spider, Thrips, Aphids	Dithane, Topsin, Nissorun, Mospilan	2 kg/he; 1 kg/he; 0.4 kg/he

Production destination - fresh consumption, but also industrialization.
In the culture of bell pepper Buzău 10 was used the culture technology specific to this species, adapted to the climatic conditions of 2019 where we had. The average temperature varied:
- in April between 9.5-14.1°C;
- in May between, 9.1-15.4°C;
- in June between 19.6 - 23.0°C;
- in July between 21.08 and 25.0°C;
- in August between 22.6 and 24.7°C;
- in September between 17.4-22.2°C.

Between April and September were the following precipitations:
- April - 0.3 l/sqm;
- May - 27.7 l/sqm;
- June - 67.4 l/sqm;
- July - 83.0 l/sqm;
- August - 33.4 l/sqm;
- September - 3.4 l/sqm.

The soil within Vegetable Research and Development Station Buzău, the agrochemical analysis found a weak alkaline pH (8.20), medium supplied in humus (2.57) soil favorable for vegetable cultivation through a value of total nitrogen (0.151%), total phosphorus (0.183%) and mobile potassium ppm (> 268) bioavailable to plant growth. (Vegetable Research and Development Station Buzău report, internal document).
Two variants were placed in the field: V1 untreated control and V5 treated with *Trichoderma*, at the time of planting. The repetition plot had 7 sqm, and the variant plot 28 sqm.
The land was modeled in raised furrows, with a height of 94 cm at the canopy and a width of 1.40 m. 2 rows of seedlings were planted on the furrow, with 70 cm between rows and 25 cm between plants per row.
Trichoderma is a genus of fungi in the Hypocreaceae family, which is present in all soils, where the most common fungi are. Many species of this genus can be characterized as opportunistic avirulent symbionts of plants. (Anil K. Sharma, Pratibha Sharma, 2020)
Fungi from the genus *Trichoderma* are commonly found in all climatic zones. The most typical habitats of these fungi include soil and rotting wood (Druzhinina I., Kubicek C.P., 2005). These fungi may be found on sclerotia and other propagating forms of fungi in the soil environment. They colonise the grain, leaves, and roots of plants. They were also isolated from such unusual sources as marine bivalves, shellfish, and termites. Fungal species from the genus *Trichoderma* are characterised by rapid growth and abundant production of conidial spores as well as the capacity to produce sclerotia (Stan N., Munteanu N., Stan T., 2003). These species produce several pigments, ranging from a greenish-yellow up to a reddish tinge, although some colourless specimens are also present. The conidia may also have diverse colouration, ranging from colourless to different hues of green or even grey or brown tinges.
Trichoderma spp. Is a saprophytic (non-pathogenic) fungus, one of the strongest in the category of antagonistic microorganisms, characterized by a high capacity for adaptation and rapid growth.

Trichoderma introduced into the soil improves the health of plants and increases disease resistance without eliminating other beneficial microorganisms.
Trichoderma also stimulates plant growth.

RESULTS AND DISCUSSIONS

The results recorded following the statistical calculation are as follows (Table 3).

Table 3. Statistical calculation - Number of fruits on bell peppers Buzău 10

No	Var.	No. fruit	No. fruit relative %	DIF	t	P %
1	V1 Mt.	6.29	100.00	0.00	0.00	-
2	V2	8.20	130.47	1.92	1.19	25.10
3	V3	8.01	127.49	1.73	1.08	29.10
4	V4	7.27	115.71	0.99	0.61	56.00
5	V5	8.09	128.64	1.80	1.12	29.10

After a long period of rain, in June and July where the water quantities were: 67.4 l/sqm and 83.0 l/sqm, the meteorological conditions favored the appearance of some diseases specific to pepper *Phytophthora capsici* (Figure 3), which is an oomycete plant pathogen that causes rot and rot of pepper fruits.

Figure 3. *Phytophthora capsici* in the cultivation of bell peppers

Later, this oomycete plant pathogen that causes rot and rot of pepper fruits was stopped with the treatments in the table above.

The administration of *Trichoderma* has had a positive influence on the culture of Buzău 10 bell pepper and is a non-polluting solution for the environment. The use of *Trichoderma* in field crops benefits the growth and production of fruit. The fruits are larger, of superior quality, in the variant treated with Trichoderma, the results being at the limit of the statistical significance threshold. (Jaimin Pandya, 2020).
Trichoderma spp. are free-living fungi that are common in soil and root ecosystems. Recent discoveries show that they are opportunistic, avirulent plant symbionts, as well as being parasites of other fungi. At least some strains establish robust and long-lasting colonizations of root surfaces and penetrate into the epidermis and a few cells below this level. They produce or release a variety of compounds that induce localized or systemic resistance responses, and this explains their lack of pathogenicity to plants. These root–microorganism associations cause substantial changes to the plant proteome and metabolism. Plants are protected from numerous classes of plant pathogen by responses that are similar to systemic acquired resistance and rhizobacteria-induced systemic resistance. Root colonization by *Trichoderma* spp. also frequently enhances root growth and development, crop productivity, resistance to abiotic stresses and the uptake and use of nutrients (Figure 4).

Figure 4. Appearance stem and root of bell pepper Buzau 10

The analysis of the root mass shows that variant 5 (treated with *Trichoderma*) (Table 4) was superior to variant 1 (Table 5).

Table 4. Analysis of bell pepper plants - variant 5

V/R	The plant	Top (g)	Root (g)
V5R3	1	171	33
	2	264	20
	3	152	49
	4	309	39
	5	234	40
	6	141	34
Average		**211.83**	**35.83**

Table 5. Analysis of bell pepper plants - variant 1

V/R	The plant	Top (g)	Root (g)
V1R3	1	185	30
	2	162	23
	3	158	28
	4	172	29
	5	133	22
Average		**162.00**	**26.40**

The weed spectrum was also performed in the field of experience, exemplified below:
- *Convolvulus arvensis*;
- *Portulaca oleracea*;
- *Setaria glauca*;
- *Amaranthus* sp.;
- *Galisoga parviflora*;
- *Chenopodium album*;
- *Poligonum persicaria*;
- *Lamium purpureum.*

The most abundant was: *Portulaca oleracea.*

CONCLUSIONS

Following the treatment with *Trichoderma* administered at planting in Buzău 10 bell pepper culture, a beneficial effect on fruit quality, development and crop production resulted.

At the same time, this fertilization is an environmentally friendly option, because it does not pollute the groundwater.

Trichoderma induces an increase in plant productivity, due in part to inhibiting the activity of toxic compounds in the root zone and increasing the absorption of nutrients. It also increases the efficiency of nitrogen use, as well as an increase in the solubility of nutrients in the soil (Rădulescu A., Coțianu R., 2004).

This fungus induces root formation and stimulates colonization with the rhizosphere and other beneficial microorganisms on the roots. It also has the ability to phytoremediation of plant tissues, caused by some residual (persistent) pesticides in the environment.

ACKNOWLEDGEMENTS

This work was supported by a grant of the Romanian Ministery of Research and Innovation, CCCDI - UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0659 / 30.03.2018 - LEGCLIM, within PNCDI III. And he continued with the support Doctoral school of plant resource engineering and management and animals, Domain: Biotechnologies, U.S.A.M.V. Bucharest. (https://www.scdlbuzau.ro)

REFERENCES

Anil K. Sharma Pratibha Sharma (2020). Host Pathogen Interactions and Applications, Springer Verlag Singapore.

Benitez T., Rincon A.M., Limon M.C., Codon A.C. (2004). Biocontrol mechanism of *Trichoderma* strains. *International Microbiol*., 7: 249-260.

Catalog Buzău Vegetable Research and Development Station, July 2013.

Chowdhury M.S.M., Hossain I., Fakir G.A., Aminuzzaman F.M., Islam M.R. (2000). Tolerance of trichoderma harzianum and gliocladium viride to agrochemicals and their antagonistic effect on seed born mycoflora of pigeon pea. *Bangladesh Journal of Seed Science and Technology*, 4, 1-2, 83-86.

Druzhinina I., Kubicek C.P. (2005). Species concepts and biodiversity in *Trichoderma* and *Hypocrea*: from aggregate species to species clusters? *J. Zhejiang Univ. Sci*. 6 (2): 100−112.

Rădulescu A., Coțianu R. (2004). *Horticultură generală și specială*. Editura Agricolă, București.

Stan N., Munteanu N., Stan T. (2003). *Legumicultură*, Editura Ion Ionescu de la Brad.

Vegetable Research and Development Station Buzău Report, Internal document.

Jaimin Pandya (2020). *Trichoderma*, Evaluation et production de masse des especes indigenes, Editions Notre Savoir, ISBN 6202842717; Harman et al., 2004 https://www.scdlbuzau.ro