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Topic 4 - Innovation in Organic farming: "thinking out of the Box"

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EFFECTS OF ORGANIC SUBSTRATES NATURE ON THE COMPOSTING PROCESS PARAMETERS AND COMPOST EXTRACT EFFICIENCY ON SOIL-BORNE PLANT DISEASES

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Abstract: Four Composting windrows were carried out by the wastes (about 8 000 kg) in pyramidal form (height 1.5 m with base of 8m x 2 m) which constitute four different treatments: 1st treatment : 100% Cattle manure, 2nd treatment : 80% Cattle manure + 20% Sheep manure, 3rd treatment : 70% Cattle manure + 20% Sheep manure + 10% Poultry manure and 4th treatment : 50% Cattle manure + 20% Sheep manure + 20% Poultry manure+ 10% crushed wheat straw. Windrows were watered every time is necessary and turned over after 15 days. Temperature rased every two days and samples rased in every turned over. The physicochemical parameters of composting process revealed that the highest temperature of windrows was in thermophilic phase and has reached 66°C for T_4 rich in carbon than for other treatments. The basic pH in the beginning decrease for all treatments and approachs the neutrality at the end of composting process, essentially for T_1. A decrease of nitrogen percentage during composting probably due to a low level of C/N ratio in the beginning.

The second part of this study starts in the maturity stage, a compost extract were prepared from different composts one volume of compost in 5 volume of water and 5 days of extraction period. The four obtained compost extracts, were experimented on different plants pathogens (Rhizoctonia solani, Fusarium solani, Fusarium oxysporum, Fusarium roseum, Fusarium graninearum and Phytophtora erythroseptica) in vivo and in vitro.

Introduction: In recent years, global awareness of health and environmental issues has been growing. The international community increasingly encourages organic and other forms of sustainable agriculture. Organic farming is based on a holistic viewpoint, the support of biological processes, the equilibrium of the agro-ecosystem, the enhancement of the structure and the fertility of the soil, the implementation of diversified crop rotation, a preventive control of weeds, pests and diseases without recourse to synthetic chemical products (Guet, 1999). Among the key characteristics of organic agriculture are the use of organic material to maintain organic matter and nutrients in the soil. Composting is an efficient

way to recycle various organic matter sources. Composting is an aerobic biological process allowing the decomposition and degradation of organic material and is characterized by different parameters such as moisture, aeration, temperature, and carbon / nitrogen ratio (Mustin, 1987).Compost extract is rich in nutrients and microorganisms and can stimulate growth, protect plants from diseases and help suppress Soil-Born pathogens (Quarles, 2001).

Material and methods: Temperature:

- pH:
- Carbon / Nitrogen ratio :

2.2.1. Pathogens agents: The pathogens tested were isolated from local potatoes tubers with symptoms of dry decay or pink rot: Fusarium roseum var sambucinum, Fusarium roseum var graminearum, Fusarium oxysporum, Fusarium solani var coeruleum, Phytophtora erythroseptica,Rhizoctonia solani. All this pathogens are multiplied at 25°C on PDA (Potato Dextrose Agar)

2.2.2. Compost Extracts were prepared from different compost treatments(T_1,T_2, T_3, and T_4) in the maturity stage of compost based on the extraction method developed by the German researcher Heinrich Weltzein. Compost extracts were obtained from a volume of compost to water ratio of 1:5. They were stirred once and allowed to ferment outdoors between 15°C and 20°C . After a soaking period (5days) referred to as “extraction time”, the solution was strained through cheese cloth and then stored in bottles in refrigerator at the temperature of 4°C. The solutions of compost extracts were kept out of refrigerator half an hour before their use.

2.2.3. Experimental design A split plot design was used with four replications and the following factors astreatments:- Factor A: compost teas- Factor B: pathogen agents

2.2.4. In vitro experiment: One ml of each compost extracts were mixed with 200 ml of PDA liquid. After stirring, this solution was put in Petri dishes. Following solidification of this medium, inoculation was made with the six pathogen agents and incubation was made at 25°C.The diameter of colonies were recorded take at : 48 hours after inoculation for Phytophtora erythroseptica 6 days after inoculation for Fusariums and Rizoctonia solani.

2.2.5. In vivo experiment: Potato tubers of Spunta variety (the most common used cultivar in Tunisia)were disinfected with sodium Hypochlorite diluted at 10% during 5 minutes. Then, tubers were cleaned with sterilised and distilled water. This experiment consists of causing injuries on the tuber (6 mm of depth) and inoculating with pathogens. For Phytophtora, 10 tubers were used with one infection site and for Fusariums we used 5 tubers with two infection sites After inoculation, the potatoes tubers were soaked in water solution with 10% of compost extracts during 10 minutes and subjected to incubation. The incubation took place in plastic containers with small quantity of water in order to increase moisture. The containers were covered by aluminium paper and put in glass greenhouse during 48hours for Phytophtora and 21 days for Fusariums. After incubation period the tubers were sliced longitudinally in two parts and the rot depth penetration was measured as follows (Lapwood and al.,1984):Penetration (mm) = (l/2 + (p-6)) / 2l: maximum width p: depth

Results: Temperature: The temperature of all compost piles were higher than ambient temperature during the composting process.

pH: The initial pH of all treatments was about 8.2 and decreased for all treatments until 7.8 to 7.4

Carbon / Nitrogen ratio: The starting C/N ratio of the treatment T_4 was higher and for all other treatments less than 15

Compost extracts experiment:

.1. In vitro tests

- Phytophtora erythroseptica: The compost extracts of all the treatments led to an inhibition of the mycelium growth of Phytophtora erythroseptica . However, there was difficulty to estimate the diameter of colonies. So, the comparison of the different treatments was not easy.
- Rizoctonia solani: thre's a significant difference between the control and the compost tea treatments. Moreover, the treatment T_4 was more efficient in inhibiting Rizoctonia solani. (Photo 1) shows clearly that after six days of incubation, the invasion of Petri dish by the fungus in the control treatment and the inhibitory effect under the compost treatment T_4.
- Fusariums: There is a significant interaction between the compost extracts treatments and the pathogens. All compost extracts had inhibitory effects on all the pathogens. The degrees of these effects depended upon both factors, compost extracts and pathogens.

.2. In vivo tests

- Phytophtora erythroseptica: The effects of the different treatments on two races of Phytophtora erythroseptica may notice that the treatments T_2 and T_3 did not have any effect. However, the treatments T_1 and T_4 had slight and big effects respectively.
- Fusariums: The tests made on potato tubers indicated that the compost tea treatments inhibited only Fusarium solani var coeruleum. (Photo 2) shows this inhibitory effect with treatment T_4 .

Discussion: The presence of a carbon source is very important to ensure a good composting process. The highest temperature during composting was obtained by the compost including wheat straw. The decrease of the pH and C/N ratio during the composting depended on the nature of the used organic matters. The in vitro tests showed that all compost teas had inhibitory effects on all tested pathogens: Fusarium roseum var sambucinum, Fusarium oxysporum, Fusarium oxysporum, Fusarium solani var coeruleum, Phytophtora erythroseptica and Rhizoctonia solani, The extracts from a compost made cattle manure, sheep manure, poultry manure and wheat straw was the most efficient. The in vivo tests made on potato tubers showed some inhibitory effects on Phytophtora erythroseptica and Fusarium solani var coeruleum. This is considered an important result since Fusarium solani seems to be the most important pathogen in Tunisian soils.

Compost extracts are easy to produce and apply an can be used for a wide range of crops. Compost extracts contains millions of bacteria, fungi and other micro-organisms that work to keep crops free of diseases (Quarles, 2001).

Our studies should be carried out in order to determine the better combination of organic mixtures, the better method of compost extracts. All the available organic matters can be composted. However, the presence of a carbon source is very important to ensure a good composting process.

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Image:

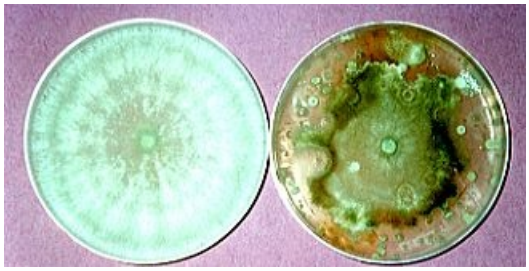
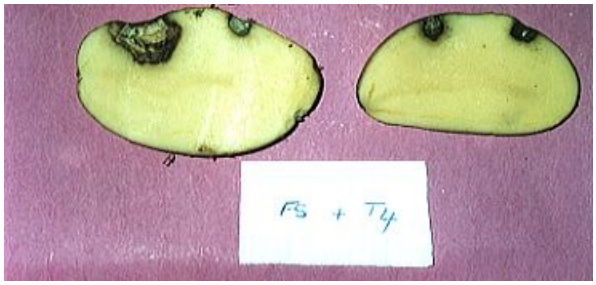


Image 2:



Disclosure of Interest: None Declared

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