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FROM THEORY TO PRACTICE – ORGANIC WASTE REDUCTION AT THE LOCAL COMUNITY LEVEL

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Abstract. Half of the quantity of waste products produced by the households is made of food remainders, vegetable and garden remainders and more of 50% of waste products are organic and they arrive in waste products storehouses, in cesspools or they are burned, causing an important pollution. To obtain quality compost, we need to lead the compost process, in accordance with the dimension, the humidity, the structure and the composition of residual materials, so that these are available to the micro-organisms fast and efficiently, making up an ideal substratum rich in nutrients for their development. The decomposition agents need the azote to build the cells and some food remainders, ripped grass and green leaves. Chips of wood, dry leaves and sawdust are rich in carbon and they constitute another energy source for the decomposition agents. The azote sources are designated as the „green" elements and the carbon sources are the „brown" ones. In a pile of compost, it is efficient to maintain a balance between the „brown" elements (carbon) and the „green" ones (azote) – in percentage of 30:1. Production of compost in schools can be a method of determining the entire school community to work together for helping the environment. It means natural recirculation of resources, community education about the benefits of compost, the change of the cultural attitude regarding garbage in a way that brings benefits to society, the reduction of the alimentary remainders quantity of the school canteen, the implication of the students in extra-curricular activities, and, last but not least, the acquirement of a fertile soil for the school garden, for planting flowers and seedlings.

If formation, information and communication are products of the educational processes, then the purpose of an educational institution is to make the students aware and responsible in relation with the environment's problems. The education for environment and for a sustainable development needs to be based on a solid

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scientific base, through the contribution of experts who understand the complexity of the environment and the interactions between geospheres.

In schools, the purpose of the activities meant to familiarize students with the environment aims at the development of the awareness and understanding capacity, the stimulation of curiosity to investigate it, the formation and the practise of some habits of looking after and preserving the environment in order to develop a positive behaviour towards it. By means of the methods used (conversation, explanation, observation, experiment, problematization, case study, learning through discovery, role-playing, education assisted by computer, learning through projects), students understand the way the environment works. Today, there are more and more vegetable waste products in different daily activities that are worthless stuff difficult to remove. One solution might be the transformation of these waste products into compost.

Composting, as an operation of controlled decomposition of vegetable remainders, has been practiced by man for centuries, with the objective of restoring the obtained humus to the soil, in order to maintain its fertility. A stable product is obtained, that does not contaminate, and that has a high nutritive value for plants and cereals - a very good enhancement to the physical and chemical state of the soils. Compost is the oldest and the most natural way to recover waste products. If the process is controled as far as the acceleration of the decomposition, the optimisation of the efficiency and the minimization of the impact on the environment and the population are concerned, composting can be also applied to green waste products / solid municipal waste products. We can make compost from organic waste products that result from domestic remainders, especially cooking waste products that are biologically recoverable, the remainders of fruits, vegetables and other aliments, and the green waste products, like leaves and cut short grass.

The compost experiment as a method for reintroducing organic waste products in the natural circuit can be made in schools, together with the students, especially in schools that have canteen and garden, orchard or park.

The composting offers responsability to schools and involves the students in extra – curricular activities. It provides the recirculation of resources in a natural way, it changes the cultural attitude regarding garbage in a way that brings benefits to society, it reduces the quantity of alimentary remainders from the school canteen and it creates a useful product: a fertile soil for the school garden, to plant flowers or seeds. During classes, the scientific notions connected to the compost production process can be easily incorporated in the schools' curricula of Natural sciences, and a circle of ecology can make the production of compost a mixt project that combines school curriculum with practical lessons in the service of the community, that can later be adopted as an official school program. The equipments and the

tools necessary to the production of compost are: compost boxes, rake and/ or shovel, spear of hay or spear garden, work gloves, thermometer for compost, wheels, buckets, a sufficient quantity of material for stuffing like leaves, chips of wood, sawdust, drums for food debris or containers with labelled wheels, sieve. The construction of the boxes for compost can be done by different members of the school community or by the school administrative staff. Another alternative is the construction of the boxes for compost as a project for students during the groups after classes, of some practical training hours, or as a tehnical project of the school.

Recommended materials	Not recommended materials
Remainders of vegetables and fruits (onion, carrot, cabbage) Tea envelopes Cardboard Towels and paper bags Cardboards for eggs and egg shells Citrus peels Coffee grounds Flowers Cut grass Human hair Hedge Home plants Water Sawdust	Cooked food Bread Fats Sauce, oil, mustard Waste from dogs and cats Disposable diapers Ashes Mud Soil Plastic products Stones Metal Aluminium containers Weeds with seeds Bones Meat Fish Glass Tetra paks Dairy products Sand

Tab.1 The content of the compost box

The best method to obtain compost in school is to make it in wooden crates of $1m^3$, with slits aeration and a detachable front side. These must be located in a convenient location, on a straight surface of grass or soil, to assure the drainage and to facilitate the access of the administrative staff. The ideal location would be a place with shadow, easily accessible because the material inside the box must remain warm, moist and with oxygen. A place must be established where to gather materials from the garden or from the orchard, like grass, leaves and remainders from the vegetation care. This will allow us to add them to the compost box

immediately after they were obtained and, on the other side, they will be at hand when we shall combine them with the food scraps in many stages. First, we gather in piles the vegetable remainders from the vegetation care, broken branches or other vegetable scraps, until we obtain a layer 10 – 15 cm thick. This is in fact a base layer for the rest of the waste products from the composting process. We can add finished compost, earth, manure or a little bit of each. Once the „bed" made of the remainders from the garden is finished, we can add organic waste products from the kitchen mixed with garden waste products. The purpose of the compost box is double. On the one hand, a big part of the waste products will not arrive at the waste products storehouses or it will not be burned, and, on the other hand, we obtain a natural fertilizer of high quality. Because of this, it is very important that the waste products inside the compost box should be organic and carefully selected, so that they do not contain plastic elements, cans, batteries or any other product that might contaminate the fertilizer that we shall produce. As regards the paper, we can put inside the compost box only paper in which food was packed, paper that does not has traces of ink. In the compost box, we can add food remainders (not treated termically), leaves, grass (but not very much because it is rich in azote), remainders from preparing coffee, eggs shells, etc. (tab. 1).

Optimal quantities of food, moisture (water) and oxygen must be provided so that the decomposition agents grow and reproduce continuously.

The decomposition agents (bacteria, fungi, mites, Collembola, wooden lice, warms, diplopoda) need azote to build their cells; and food remainders, the cut grass and the manure are excellent azote sources. Wood chips, dry leaves and sawdust are rich in carbon, a source of energy for the decomposition agents. In the specialty jargon, the sources of azote are designated as „green" elements, and the sources of carbon are the „brown" ones. In a pile of compost, it is efficient to maintain a balance between the „brown" components (carbon) and the „green" ones (azote) – in a percentage of 30:1, in order to offer the decomposition agents a balanced nourishment.

The alternation of layers of brown and green components helps maintaining this balance. The „brown" components are also called „materials for stuffing". The reason is that, as they are dryer, they do not allow the pile of compost to be burden - it remains light and loose - and they allow the free circulation of the air. A pile of compost that is too moist and compact will start to smell, because of the anaerobic bacteria action (bacteria that doesn't need oxygen to grow). It needs to be wet, but not flooded with water. The food has a high content of water and it is usually wet enough to maintain the moisture of the pile of compost. By regular turning, the pile is aerated and the brown and green waste products are mixed.

Water content is essential for all living organisms. Most microorganisms are very sensitive to the existence of this factor in their environment. When the

moisture of an active blend of a pile of compost decreases under 35 – 40% (when water content represents 34 – 40% of the total weight), the decomposition speed is reduced significantly as microorganisms are not able to continue their metabolic activities; at a moisture lower than 30%, they permanently cease their activity.

On the other hand, too much moisture creates the ideal conditions for and leads to the rapid appearance of anaerobic microorganisms, as the water fills the tiny spaces of the blend. This situation leads to the disappearance of spaces for air, situation that does not favour the existence of microorganisms that consume oxygen (aerobic microorganisms), but the anaerobic ones appear. When the quantity of oxygen is insufficient, the conditions favorise the anaerobic microorganisms, and these lead to the appearance of a less effective process and nasty smells.

This way, the moisture content and the oxygen availability are linked: while microorganisms need moisture, material that is too wet and too heavy will not have spaces for the air to circulate between particules. The ideal status is the one in which the material is moist, but not wet, that means when it is squeezed into your hand, the moisture should make itself felt, but the water must not drip. If the material in the hand is friable when it is squeezed, than it needs water. If, on the contrary, the material has too much water, we can add dry material in the box (sawdust, dry leaves) and drain/ monitor the box trickling.

The fresh alimentary remainders are always stored in the first box. When this one is full, its content is transferred in the second one. Meanwhile, in the first box we start to collect again fresh alimentary remainders. When the first box is full again, the content of the second one is transferred in the third box and the content of the first box in the second one. The process restarts in the first box and the sequence continues, according to how many boxes we have. We reserve the first box for the fresh waste products from the kitchen and garden. The more carefully shall we mix in the appropriate proportions the green and the brown waste products, the higher will be the compost's quality, from the beginning. Every time we add new material, the volume will decrease again.

In practice, the optimal blend is not always possible. In summer, there is always a grass excess, in autumn, there are always more leaves. We need to keep the brown waste products nearby, as every time we add in the first box remainders from the kitchen, we need to mix them with stuffing materials. The second box is kept for what will result after the first turn. With a pitchfork, we take out the material of the first box. We get everything out and we clean it very well, we mix, aerate, then we introduce it in the second box. The process of producing the compost reaches the maximum point with the strong heating of the compost. An increase of the temperature up to 50^0C or even more is expected. This is important especially when the process of turning into compost is somehow evolved and when

it rains regularly. The compost must not be directly covered with wood or plastic. It is important that the air can circulate between the compost and the roof. The third box must be covered. It is the stage where the molds are responsible for continuing the process, and these, unlike the bacteria that operated in the initial stage, work much better in conditions of more reduced moisture. The maturation and the nitrification that accompany the process (transforming the ammonia into nitrate) are enhanced if the material is somehow drier. The pH of the dry compost is also neutral. Finally, compost a little bit drier is easier to manipulate: drier compost is easier and it is much easier to take it with the shovel, to sieve it and to spread it on the ground.

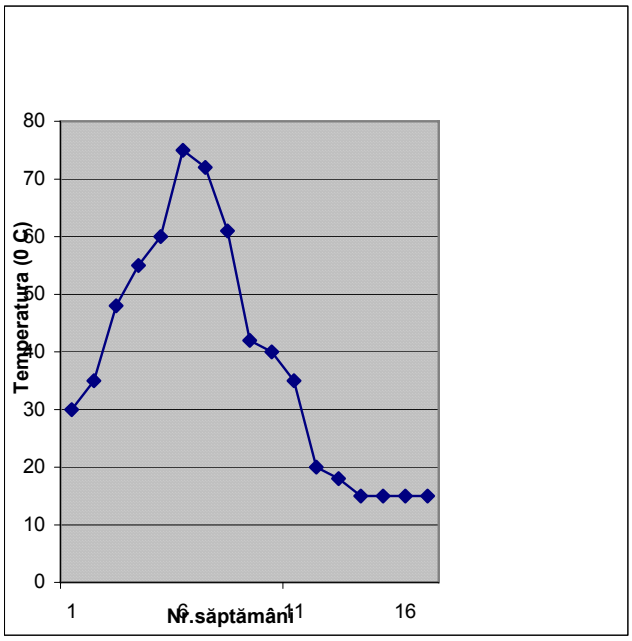

Fig.1 The temperature variation in the compost box

We identified three main phases of the composting process (fig. 1):

- phase 1, *the stage of mezofil fermentation*, which is characterized by the growth of bacteria and temperatures between 25 and 40^0C;

- phase 2, *the termofil stage* in which bacteria, fungi and actinomicetes (the first level of the consumers) are present, at a temperature of 50-60^0C, decomposing the cellulose, the lignite and other resistant materials; the superior limit of the

termofil stage can be of 70^0C and it is necessary to maintain the temperature high for at least a day to assure the destruction of the pathogens and contaminants;

- phase 3 is *the maturation stage*, where the temperatures decrease and grow stable. Some fermentations continue, converting the degraded material into humus by reactions of condensation and polymerisation; the last objective is to produce a material that is stable and can be judged regarding the C:N proportion.

Materials well composted have a reduced C:N proportion. The C:N proportion can decrease from 30, at the beginning of the composting process, to 15 in mature compost.

Volunteers among students and administrative staff will have to be trained about the daily activities related to the processing of the alimentary remainders. The programming of these tasks depends on the school lunchtime, on the availability of the volunteers and on the elements that are mostly favoured by the staff of the kitchen and the caretaker involved in the programme. A team of two or three students, supervised by an adult, can complete the following daily tasks in about 15 minutes.

Task 1: Food scraps collecting

Task 2: Food scraps weighing

Task 3: Transportation of food scraps to the boxes

Task 4: Compost temperature measuring.

This activity must take place daily for a while (for example, before and after the turning). The long probe of the compost thermometer is pushed carefully in the center of the compost pile, where it is the warmest. The temperature is read and registered in the table. Measuring the temperature in the pile of compost is a method of measuring the progress of the transformation process of the alimentary remainders in compost. A pile of compost at work passes through certain phases, becoming warmer as the decomposition agents work and reproduce, and then it gets cold. If compost gets cold before most of the decomposition has taken place, it is a sign that the proportion between alimentary remainders, air and materials for stuffing must be adjusted. Usually, a decrease in temperature indicates that it is time to turn the pile by transfering it in the next compartment for compost.

Task 5: Foodscraps spreading.

Task 6*:* Applying the stuffing material layer.

Task 7: Cleaning.

The final compost can be otained after approximately 5 months and it has the following qualities: it smells and it looks like the soil of the forest, the finished material is uniform, the colour is dark (black or dark brown), it does not contain easily identifiable materials, it contains a limited number of seeds with germination capacity, the pile decreased up to 1/3 of its initial volume and it does not heat up.

The use of compost as fertilizer contributes to the improvement of the soil structure and of its resistance to erosion; it supplies nutrients necessary to the development of plants, because the release of nutrients in the soil is gradual; compost permanently provides fertilizers to the soil; the soil fauna increases, especially earthworms that contributes to aeration; the adverse effects of the toxic agents like pesticides or heavy metals are reduced because no chemical fertilizers are used; the soil capacity of retaining the water increases; some pathogen factors are removed from the soil; it softens the very clayey soils; it solves the climate changes problem, because compost retains the carbon dioxide at ground level.

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