Composting of bio-waste, use of compost in agriculture 1997

Contractor: Joanneum Research, Institute f. Environmental Geology and Eco-System Research

Customer: Styrian Provincial Government - Specialised Division 1c

Participants: Waste Management Association Fürstenfeld
Companies of the district of Fürstenfeld

Date of Publication: January 1997

1. Summary

The study showed that the following items should be increasingly taken into account in practise when it comes to composting and using compost.

- Water content of the input material and during the rotting process:
  Material that is too dry or too humid will stop the rotting process. Therefore, it is indispensible to make sure the material has the right humidity throughout the rotting period (for practise, the "fist test" is sufficient). If necessary, there must be irrigation or the stack must be transplanted.
- C/N ratio of the input material:
  The carbon/nitrogen ratio also is important for a good rotting start and process. The optimal C/N ratio of the input material is between 20 - 30:1. The more ligneous a material is the more carbon is contained; the fresher and greener it is the more nitrogen is contained. At composting of graveyard waste, in particular, it is particularly important to make sure that sufficient material with a higher nitrogen content is admixed.
- Heating the stack
  A good rotting process is characterised by heating the stack in the first rotting weeks. Often the required temperatures fail to be reached or the rotting process is stopped by too high or too low a water content of the input material or lack of oxygen. In this case, the measures necessary (admixing dry material, transplanting or irrigating) must be taken as soon as possible.
- Maturity of compost - plant compatibility:
  When using compost, the correct maturity of compost is of utmost importance. If compost is to be used as a mulch material (do not mix it in), it will be ready for use as early as shortly after the heat phase has faded away. In this context, the question as to whether the material is odourless may serve as a criterion. If compost is used as a fertiliser, a visual check will be sufficient. The stack should have cooled down for some weeks, the majority of the stack should have a crumbly structure and the odour should remind of forest earth.
- In order to prevent compost from causing burns and germ inhibition, a test for plant compatibility is recommended. High-quality compost won't damage plant roots or seeds. The "more matured" compost is the better will its effect on the humus build-up of the ground be.
- Composting of graveyard waste
  Graveyard waste mainly consists of very ligneous dry material (wreaths, garlands). Therefore, particular importance has to be attached to the correct C/N ratio (admixing sufficient nitrogenous material) and the correct water content of the material when composting.

2. Starting Position

The separate collection of biogenous waste and its composting take a central position in the overall Styrian Waste Management Concept. In rural areas, in particular, implementing composting covering large areas is an important pivot leg. For maintaining natural cycles, it is quite obvious the organic materials taken from agriculture should be fed to the soil in the course of composting again. What, however, should be noted is that it is not "thinking in terms of waste disposal" that should be in the centre of all these deliberations but the protection of the soil and its health.

3. Goals

The study for which the Styrian Provincial Government has placed an order deals with the following topics:

- first part: opportunities of using biogenous waste for composting in farms
- second part: use of bio-waste compost and its effects on the soil and the plant yield

4. Procedure

For this, the rotting process of six bio-waste stacks and six stacks of graveyard waste were tracked in two different farms belonging to the Association Area Deutschlandsberg for four years. Then the effects of the bio-waste compost were studied in a three years' field test and these effects were compared to those of mineral fertilisers. The investigation programme comprised various parameters of soil chemistry, physics and biology, the additional vegetation and the yield. For assessing the quality of the final product, 16 finished composts from comparable farms of the District of Deutschlandsberg were also incorporated into the evaluations.

In principle much importance was attached to reflecting the practise of agricultural composting in the results, which is why the farmers were given a free hand in their techniques.

The second part of the study dealt with the effect of bio-waste compost on the condition of the ground and on the cultivated plants. The area studied was arable land covering a surface of 0.5 ha, which was randomly subdivided into 4 areas where mineral fertilisers were used and 4 areas where compost was used.

The crop rotation consisted of corn (1994), summer barley and colza as intermediate crop (1995) and corn (1996). A series of abiotic and biotic parameters was determined for three years. The finding was that the mosaic of grounds that was highly different in small areas led to more distinct differences in the characteristics of the ground than the two different variants of fertilisers and that this made it very difficult to allocate certain effects to single influencing variables. A negative impact of bio-waste compost on the yield or ground could not be identified.

On the whole, the compost variant had lower variations in nitrogen content (overall nitrogen and Nmin) in the course of three years of investigations than the variant with mineral fertilisers. The same is true for potassium content. This might hint at the fact that the release of nutrients is more gentle and "more continuous" when using compost than at the use of mineral fertilisers.

5. Result / Benefits

The composition of the stacks of the individual farmers was only slightly different in terms of their mixing ratios. The mean bio-waste share amounted to 50 to 70 wt%, mixed with about 11 to 20 wt% grass clippings, 1 to 7 wt% stable droppings, straw and earth 0.1 and 0.5 wt% rock meal.

As has been shown, the (pure) composting of graveyard waste, which was practised in the studied farms, will be retarded by too low C/N ratios and therefore will, quite often, fail to reach the hygienisation temperatures specified in the ÖNORM S 2200 (ÖNORM - Austrian Standard). Nevertheless, the investigations into epidemic related hygiene showed " harmlessness in terms of epidemic related hygiene" for composts.

An important criterion for using compost in agriculture is its high nutrient content.

The content of overall nitrogen in the studied bio-waste compost was between 0.9 and 1.5 % in the dry substance. The content of overall nitrogen in graveyard compost was, as could be expected, made to be lower by the higher share of ligneous material and was between 0.5 and 1.1 % in the dry substance.

The mean overall phosphorus content in all the studied composts was between 0.58 % in the dry substance; the share of phosphorus available to the plants amounted to 0.18 %. The mean overall potassium content amounted to 0.87 % in the dry substance; the mean share of potassium available in the compost amounted to 0.57 %, the compost of chicken droppings of one farm used for comparison had the highest share of potassium available to plants with 3.05 %.

The mean calcium content of the composts amounted to 2.75 % in the dry substance, the mean magnesium content to 0.64 %.

It was only in the share of phosphorus available to plants and in the nitrogen content that there were significant differences between the bio-waste composts and the graveyard compost.

The mean boron content amounted to 4.36 mg/kg dry substance, the boron content of the graveyard stacks being much lower than that of the bio-waste composts.

Another important parameter for assessing the quality of final composts is their content of heavy metals.

50 % of altogether 34 studied finished composts succeeded in keeping the limits of Class I of ÖNORM S 2200. In 18 % of the composts, the limits of Compost Class I were exceeded in terms of the heavy metals copper, nickel, lead (most frequently), zinc and mercury.

The load of the composts with lead was due to the load of the input material (material in bins for bio-waste, shrub and grass clippings) while the increased concentrations of lead in graveyard compost resulted from plastic and metal residues left by garlands and wreaths.

In 32 % of the composts, the limit of Class II was exceeded in connection with the heavy metals chromium, mercury, cadmium and zinc, the limit for chromium being exceeded most frequently.