The microbiological population of composts of stable manure at different temperatures

An Abstract

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One of the major problems in the composting of organic materials, such as stable manures, is the rapidity of their decomposition and the conservation of soluble plant nutrients, especially nitrogen. The temperature at which the decomposition processes take place is one of the most important factors in controlling the rate of decomposition of the manure and conservation of the nitrogen. This is accomplished through the control of the microbiological population which is concerned in the decomposition processes.

In the early stages the most rapid decomposition of horse manure was at 65°C.; after the initial period the processes were found to proceed more rapidly at 50°C. than at 65°C. A temperature of 75°C. was unfavorable for microbial decomposition of the manure; at this temperature, cellulose was not attacked at all, and the hemicelluloses were decomposed only to a limited extent; there was little synthesis of microbial cell substance; a part of the lignin was made soluble. At 28°C. there was considerable delay before active decomposition set in; however, after a lapse of about ten days the manure began to decompose rapidly due to the development of an extensive microbiological population.

The microorganisms concerned in the decomposition of manure at different temperatures were found to be highly characteristic: At 75°C. only certain spore-forming, hemicellulose-decomposing bacteria were active; the animal population and the fungi were completely repressed; actinomycetes were present but were not very abundant. At 65°C., bacteria and actinomycetes were largely concerned in the decomposition processes; fungi appeared only seldom and animal forms were absent. At 50°C. certain thermophilic fungi were active in addition to the bacteria and actinomycetes; this selective population, in which fungi and actinomycetes played the predominant role, was responsible for the most rapid decomposition of the manure. At 28°C., the population was highly heterogeneous, comprising bacteria, fungi, actinomycetes, protozoa, and nematodes.

No organism capable of decomposing cellulose was active at 75°C. Cellulose was decomposed at 65°C. by thermophilic anaerobic bacteria and certain thermophilic actinomycetes. At 50°C. thermophilic fungi and actinomycetes played the predominant role in decomposing the cellulose. At 28°C. aerobic bacteria, belonging to the Cytophaga and other groups, were most active. Nitrogen was conserved in the manure only when immediate decomposition took place. This resulted in a rapid breakdown of the carbohydrates and the transformation of soluble nitrogen into insoluble forms. Whenever decomposition was delayed, either because of too low or too high temperatures, considerable losses of nitrogen occurred. After the rapid decomposition phases were completed, in about 30 days, nitrification took place at 28°C. and at 50°C.; only a trace of nitrate was formed at 65°C., and the ammonia which resulted from the secondary decomposition processes accumulated.

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