

Compost N-mineralization emanated from natural Xerophytic Mediterranean Vegetation debris, soil application and the effects of zeolite

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Introduction

The management of plant raw material produced by the maintenance of natural Xerophytic Mediterranean vegetation during a reforestation project is a difficult procedure, due to the high lignin content and the lack of efficient management plans by the local authorities. Nowadays, in most cases green wastes are crumbled by a shredder and applied on soil surface, increasing fire risk during xerothermic seasons. There are also cases that wastes are discharged unexploited to landfill sites causing: a) rapid filling of landfills, b) increase in fire risk; fires can be also spread from landfills to residential areas, c) burden municipalities with fees, which are related to transportation, to fuels for municipal trucks, routes to and from the landfill sites, machinery and vehicles damages, and (d) environmental and social impacts due to objections raised by residents when local authorities try to find new landfill areas.

This study aims to highlight the advantages of composting green wastes produced by the maintenance of natural Xerophytic Mediterranean vegetation (lignin-rich plant raw materials) during a reforestation project by using also other agricultural additives (zeolite) to produce a safe and environment friendly product, appropriate for application to forest ecosystems, avoiding a) soil transportation which is related to possible transport of pathogens, and weed seeds and b) the use of chemical fertilizers.

Materials and methods

For this, a 65 hectares reforestation area in Egaleo mountain (Attica, Greece) was selected. Egaleo mountain is the natural ending of Parnitha mountain at the Saronic gulf and is located at the west side of Attica basin. The general exposition of the area described as various and the altitude is 204-372 m. The slopes are gentle to moderate 8-25%. According to Bioclimatic Maps of Forest Research Institute of Athens the area is classified in the semidry bioclimatic level (Mavromatis, 1978). The type of Mediterranean Bioclimate is intensely Thermo-Mediterranean. The area is described as bushy-grassland (Forest Map of Attica). The natural vegetation of Egaleo mountain belongs to evergreens, hard-leaf zone of *Quercetalia ilicis* and in the vegetative place of *Oleo-ceratonion* (Dafis, 1986), (Vegetation Map of Greece). The reforestation area is mainly occupied by the secondary growth of brushwood, with main specie the *Phlomis fruticosa*. It is also occupied by the secondary growth of bush from evergreens-broadleaves of *Oleo-Lentiscetum* phyto-social union, with intense degradation.

Green wastes of the reforestation project were collected, crumbled by a shredder and composted with urea (H_2NCONH_2) (46-0-0). The feedstock mixture was contained unhealthy or creeping branches of trees and bushes, and a great percentage of brushwoods. The feedstock consisted of 40% conifers (*Pinus halepensis*, *Cupressus sempervirens*, *Juniperus phoenicea*), 30% bushes (*Quercus coccifera*, *Pistacia lentiscus*), 20% brushwoods (*Phlomis fruticosa* e.t.c.), 10% broadleaved trees (*Olea europea* subsp. *oleaster*, *Ceratonia siliqua*, *Cercis siliquastrum*) and a minimal percentage of underbrush vegetation. Composting phase lasted 7 months and during this period the pile was monitored as regard temperature, moisture and oxygen content. The temperature increased to 50-55°C for 30-40 days.

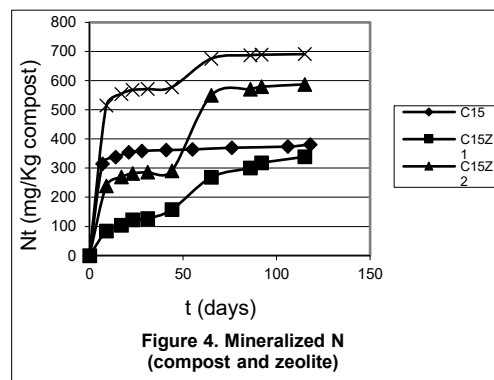
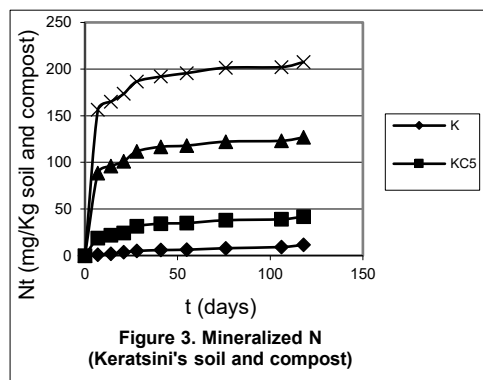
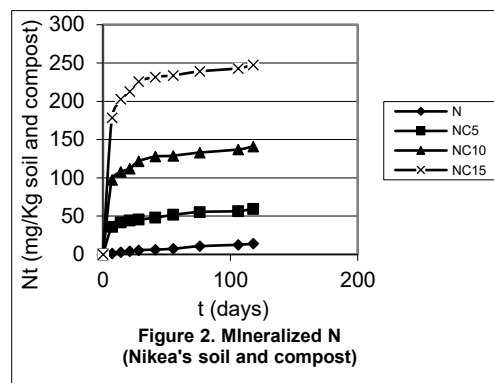
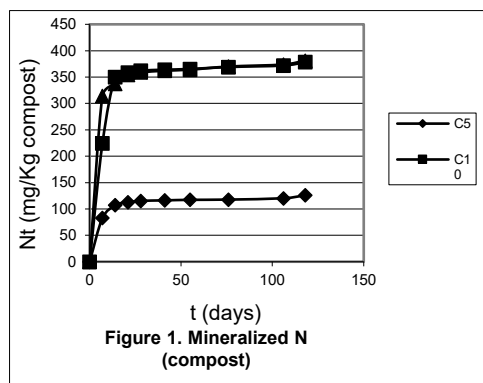
The mineralization of nitrogen in compost was investigated in a laboratory experiment. Four compost-soil mixtures were prepared with soil of two different areas of Egaleo Mountain (Nikea and Keratsini) and compost-zeolite mixtures were prepared with clinoptilolite. The treatments were the following: i) 5 g (C_5), 10 g (C_{10}), 15 g (C_{15}) compost ii) 15 g soil of Nikea's section (N) with 5 g (NC_5), 10 g (NC_{10}), 15 g (NC_{15}) compost iii) 15 g soil of Keratsini's section (K) with 5 g (KC_5), 10 g (KC_{10}), 15 g (KC_{15}) compost iv) 15 g of compost with 1 g ($C_{15}Z_1$), 2 g ($C_{15}Z_2$), 3 g ($C_{15}Z_3$) zeolite. All the samples were mixed with 15 g of quartz sand and were placed in plastic cylindrical pipes for incubation. The samples incubated in the laboratory for 119 days according to procedure suggested by Stanford and Smith (1972), for the determination of the mineralizable nitrogen (N_i).

Results and discussion

The maximum intensity of N-mineralization process was observed in the first 15 days for the compost samples and in the first 30 days for the compost-soil samples. As long as the amounts of compost were increased in the compost-soil samples, higher concentrations of N-mineralized occurred.

The same amounts of N-mineralized in samples C₁₀ and C₁₅, was observed. The concentrations of NH₄⁺-N were higher in the C₁₅ samples, while the concentrations of NO₃⁻-N were almost equal. Cause of the intense microbial activity in C₁₅ samples, there were increased requirements of oxygen. Possible anaerobic spots were presented during the incubation that enhance the de-nitrification.

The N-mineralization for the compost-zeolite mixtures, was in progress during the 119 days of the experiment. Higher amounts of zeolite in compost-zeolite mixtures resulted in higher concentrations of N-mineralized. At the 40th day of the experiment, the zeolite saturated by NH₄⁺-N, which were produced by the ammonification process and K⁺ of the nutritious solution. The NH₄⁺ ions which were not participated to the zeolite saturation were transformed to NO₃⁻ by the nitrification process, and therefore higher amounts of N-mineralized were observed. At the end of the experiment, higher concentrations of N-mineralized at the compost-zeolite mixtures were observed than the pure compost samples.



Conclusions

Compost made by debris emanated from natural Xerophytic Mediterranean Vegetation and zeolite could be a suitable substrate for reforestations projects, quarry and mine rehabilitation and agriculture due to the benefits on the balanced nutrients availability to plants for a long period.

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