

# Effect of temperature on soil microbial biomass, enzyme activities, and PLFA content during incubation period of soil treated with organic materials

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## Abstract

This study was carried to evaluate the effect of temperature on soil microbial biomass, enzyme activities, and phospholipid fatty acid (PLFA) content during incubation period of volcanic (VAS) and non-volcanic ash soil (NVAS) treated with organic materials such as 2 types mixed pellet (OFPL) and powder organic fertilizers (OFPD), pig manure compost (PMC), and food waste compost (FWC). Soil microbial biomass N was high in NVAS treated with organic fertilizers and in VAS treated with PMC and FWC, respectively. At 75 days, PLFA content was higher in NVAS than in VAS. Urease activity in NVAS treated with OFPL followed the order of 10°C (75.0) > 20°C (16.3) > 30°C (4.6 ug NH<sub>4</sub>-N/g/2h) at 150 days. It was decreased gradually at the high temperature and with time. Glucosidase activity was higher in NVAS than in VAS. The correlation coefficient between soil microbial biomass C and microbial activity indicators showed that PLFA was highly significant at r=0.91 in NVAS and for glucosidase was r=0.83 in VAS. Soil microbial activities showed differences in sensitivities depending on soil type and temperature.

## Key Words

Volcanic ash soil, organic materials, PLFA, soil enzyme, microbial biomass C, N

## Introduction

Environmental factors such as soil type (volcanic or non-volcanic ash soil, etc.), temperature, soil moisture, application of organic fertilizers play an important role in microbial activity. Soil microbial activity was low due to the properties of allophane in volcanic ash soil. When soil temperature was high, organic matter decomposed easily in soil, but some organic matter was resistant against decomposing process because of its constituents. Nutrient release from organic matter and soil microbial activity were affected by soil characteristic, temperature, and organic matter type. This study was carried out to evaluate soil microbial activities according to soil temperature in two soils treated with organic materials.

## Methods

### Treatment

Experimental soils were mixed well after adding water to 50% of soil moisture content and 2g of four organic materials added to volcanic (VAS) and non-volcanic ash (NVAS) soil (30g < 2 mm). The soils were incubated at 10, 20, 30 °C. Soil samples were taken to analyses microbial biomass C and PLFA at 75 days, microbial biomass N and soil enzyme at 150 days. Soil samples stored immediately at 4 °C for soil enzyme activity and biomass C, N and at -20 °C for PLFA analysis.

### Analysis

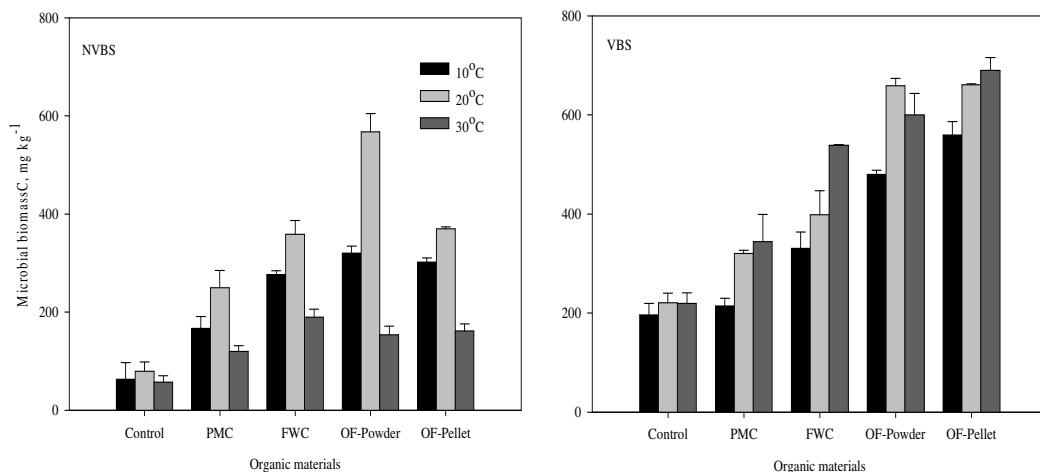
Dehydrogenase activity was measured by the triphenylformazan method (Rossel and Tarradellas 1991). Urease (Tabatabai 1976) and β-glucosidase (Garcia *et al.* 2000) activities were measured by the THAM buffer method. PLFA analyzed with GC - FID instrument after Bligh/Dyer first-phase extraction (Bligh and Dyer 1959). Biomass C (Vance *et al.* 1987) and N (Amato *et al.* 1988) were measured by the Ninhydrin method.

## Results

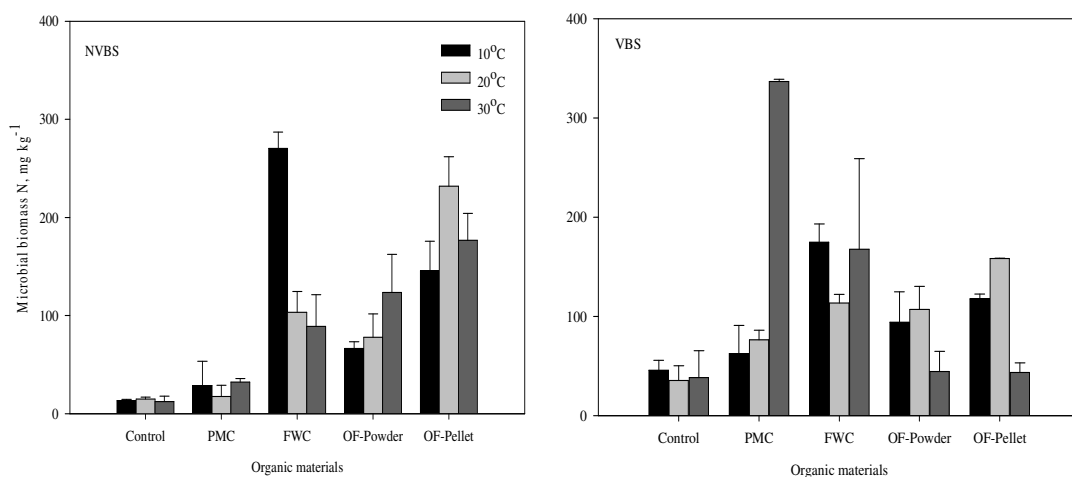
Soil microbial biomass C was high when soil temperature was high for both OFPL and OFPD treated VAS (Figure 1). Soil microbial biomass N was high in NVAS treated with organic fertilizers and in VAS treated with PMC and FWC, respectively (Figure 2). At 75 days, PLFA content was higher in NVAS than in VAS (Figure 3). Urease activity in NVAS treated with OFPL showed in the orders of 10 °C (75.0) > 20 °C (16.3) > 30 °C (4.6 ug NH<sub>4</sub>-N/g/2h) at 150 days. It was decreased gradually with temperature and time, and was high at 10°C in VAS. Correlation coefficients between soil microbial biomass C and microbial activity indicators showed that PLFA was highly significant r=0.91 in NVAS as glucosidase r=0.83 in VAS (Table 1).

**Table 1. Correlation coefficient between microbial activity indicators and microbial biomass C content.**

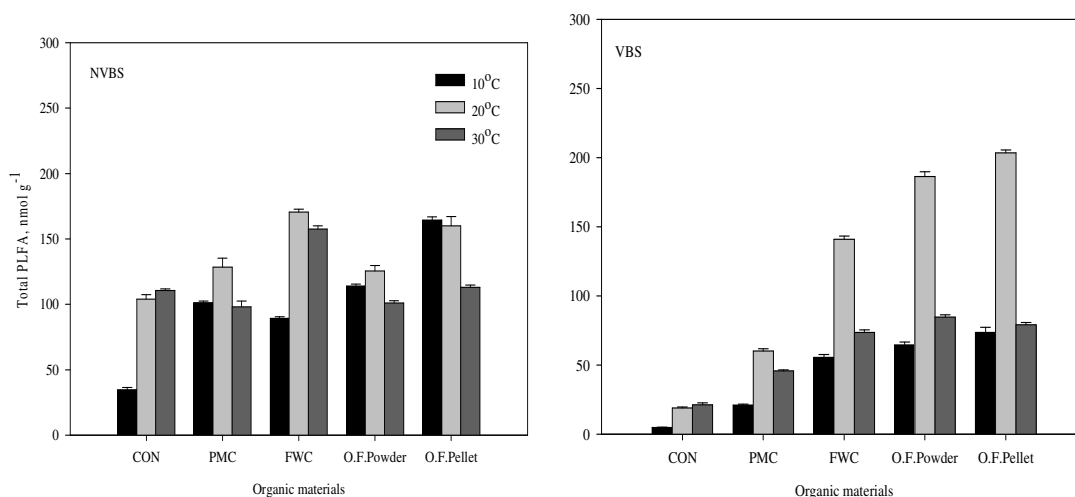
Temperature (°C)	Non-volcanic ash soil				Volcanic ash soil			
	10	20	30	Average	10	20	30	Average
Biomass N	0.47	0.60	0.46	0.51	0.47	0.54	0.76	0.59
PLFA	0.93	0.83	0.96	0.91	0.90	0.44	0.25	0.53
Glucosidase	0.77	0.77	0.38	0.64	0.95	0.80	0.74	0.83
Urease	0.66	0.51	0.37	0.51	0.41	0.79	0.58	0.59



**Figure 1. Soil microbial biomass C content after incubation at 75 days in NVAS and VAS.**



**Figure 2. Soil microbial biomass N content after incubation at 150 days in NVAS and VAS.**



**Figure 3. Total-PLFA content after incubation at 75 days in NVAS and VAS.**

## Conclusion

Soil microbial biomass C showed high when soil temperature was high and both OFPL and OFPD treated in VAS. Soil microbial biomass N was high in NVAAS treated with organic fertilizers and in VAS treated with PMC and FWC, respectively. Urease activity decreased gradually with temperature and time. Glucosidase activity was higher in NVAAS than in VAS. Soil microbial activity showed differences in sensitivity with soil type and temperature.

## References

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