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EFFECT OF AIR DRYING OF SOIL ON NITRIFICATION AND MINERALIZATION

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Abstract: A laboratory incubation experiment at 15 °C was carried out on nitrification and mineralization in fresh and air-dried soils at Glasgow University, Glasgow, United Kingdom. The air-dried soils showed a clear lag period before nitrification started. The nitrification rates were significantly slower (P<5%) in air-dried soils samples than fresh soils. The mineralization rates were significantly greater (P<5%) in air-dried soils than fresh soils.

Keywords: Air dried soil, fresh soil, nitrification rates and mineralization rates.

INTRODUCTION

Fertilization practices are often a reflection of the weather conditions that are likely to be encountered in the area. This is particularly true with nitrogen since its behaviour in soil is greatly influenced by physical, chemical and biological parameters. Laboratory incubation experiments are usually well defined in term of soil sampling, moisture content, quantity of micro-organisms and temperature and are, therefore, considered less complex than natural environment. They do however, provide a useful model for predicting nitrogen behaviour under field conditions and checking of loan utilization. In past, Myers [1974] and Seifert [1980] used air-dried soil samples to see the effect of temperature. Schmidt and Belser [1982] recommended freshly collected soil samples with minimum disturbance for study of microbe's activities in soils. However, some researchers are still using air-dried soil samples in nitrification experiments such as Malhi and McGill [1982] used three air-dried soils for measuring nitrification at –4 °C, 4 °C, 10 °C, 20 °C, 30 °C and 40 °C. Yousaf [1985], McCarty and Bremner [1989] who have used air-dried samples for aerobic incubation for nitrification and mineralization studies. While Addiscott [1983], Flowers and O' Challaghan [1982] and Mazumdar [1992] have used freshly collected soil samples for incubation in their studies of nitrification and mineralization. Khan [1987] compared the effect of fresh and air-dried soils samples on nitrogen mineralization. This short review of literature show that there is no single paper which directly compares the effect of fresh and air-dried soil on nitrification with applied ammonium sulphate as substrate. In the present study it was planned to compare rates of nitrification and mineralization in fresh and air-dried soils for accurate prediction of nitrogen behaviour in soils.

MATERIALS AND METHODS

Five soil samples, two (Midelney and Freckenham) from England and three (Darvel, Dreghoran and Darlieth) from Scotland were collected for the laboratory at Glasgow University, Glasgow, United Kingdom during 1995. The incubation temperature at 15 °C was carried out for measuring nitrification and mineralization in fresh and air-dried soils of each soil with sample of 50 g of soil in a 500 ml glass bottle. The each sample was treated with 100 mg N per gram by adding 1 ml of ammonium sulphate solution containing 5000 mg ammonium nitrogen per litre in four replications. The each soil sample was mixed thoroughly using a spatula and the moisture content was adjusted to the –0.5 Bar moisture potential by addition of an appropriate weight of deionized water with Pasteur pipette. The glass bottle containing the sample was allowed to stand in the cold room at 2 °C for 3 hours. After taking a sub sample for measuring extractable N at day Zero, each bottle was then placed in the incubation in a plastic tub lined with damp filter paper and containing water in base to ensure humid atmosphere in order to keep the samples at correct moisture content at fixed temperature. The change in ammonium, nitrate and nitrite were measured at intervals by extraction from sub samples. In order to determine rates of nitrification and mineralization in samples soil measured values of ammonium disappearance, nitrate formation, and total of ammonium and nitrate were regressed on time on computer Minitab Package (Version 7.2). To test the significance of effect of air drying on rates measured were pooled into two regression lines. A Pooled t-test was used to test the difference between the two regression slopes.

RESULTS AND DISCUSSION

Results presented in Table 1 show that ammonium disappearance and nitrate formation rates were significantly higher in fresh soil samples than that of the air-dried samples. The air-dried soil samples also showed a short lag period in ammonium disappearance and nitrate formation. Therefore incubation period was long, whereas in the fresh samples lacked this lag period and incubation period was short. The nitrate formation curves for air-dried soil samples appeared to be sigmoid curve while for fresh soils, ammonium disappearance and nitrate formation fitted a straight line and zero order rates were calculated for nitrification rates from first day of incubation. For detail study of graph and Model rates of nitrification and mineralization are available in the thesis by Amin [1995].

Anderson *et al.* [1969], Myers [1974] and Seifert [1980] used air-dried soil for determination of nitrification at different temperatures. In general their results indicated long incubation period (6-8 weeks), wide sampling interval (1-2 weeks) and slow ammonium disappearance and nitrate formation. Great variability is seen in measured values and the lack of sufficient points makes it difficult to draw lines to see the shape of

nitrification curves. Addiscott [1983], Flowers and O' Challaghan [1982] and Mazumdar [1992] used fresh soils and Shah [1988] used fresh coal mine spoils for measuring nitrification rates. Their results showed short incubation periods, more frequent sampling very low variability and clearly defined lines indicating no lag period.

Table 1: Nitrification rates in fresh and air-dried soils.

	Fresh soils	Air-dried soils
	(mg N per kg of soil per day)	
1-Darvel soil		
Ammonium disappearance rates	16.4 b	12.1 a
Nitrate formation rates	17.6 b	13.6 a
Mineralization rates	01.9 a	02.8 b
2-Dreghoran soil		
Ammonium disappearance rates	6.5 a	5.9 a
Nitrate formation rates	8.8 b	7.4 a
Mineralization rates	1.2 a	1.3 a
3- Midelney soil		
Ammonium disappearance rates	27.2 b	20.6 a
Nitrate formation rates	27.1 a	25.5 a
Mineralization rates	N.I.	04.3
4- Freckenham		
Ammonium disappearance rates	11.9 b	08.2 a
Nitrate formation rates	13.3 b	10.5 a
Mineralization rates	01.4 a	02.3 b
5- Darlieth soil		
Ammonium disappearance rates	12.2 b	08.1 a
Nitrate formation rates	13.0 b	11.4 a
Mineralization rates	01.1 a	03.3 b

1) N.I. mean Nitrogen Immobilization.
2) Data in a row with same subscript letter are significantly different at 5% level (Pooled t-test).

In the present investigation rates were calculated by two ways from the linear part of the graphs of the ammonium disappearance and nitrate formation. The nitrate formation rates were slightly higher compared to ammonium disappearance in five soils due to mineralization. The reason for slower nitrification rates in air-dried soil might be reduction in population of *Nitrosomonas* and *Nitrobacter*.

The mineralization rates were higher in air-dried soils than that of the fresh sub samples of all soils due to the death of general population of microorganisms, decomposition of organic matter and disturbance of soil structure. Air drying and storage of soils are known to affect soil properties [Birch 1958] and microorganisms [Ross and McNielly 1975].

The results and discussion clarify previous findings and help the points for accurate prediction of fertilizer application in soils and its behaviour.

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