

The Effect of Moisture on the Experimental Determination of the Metabolic Activity of Soil Microorganisms

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A microbiological approach to the study of the ecology of certain grassland plots has been underway for the past two years (2, 3). Part of this study has involved the determination of the gross metabolic activity of soil microorganisms of the plots under study. Since only comparative studies have been made, water has been added to soil samples to accelerate respiration rates in the Warburg manometric flasks. The addition of the water created a variable that could affect the validity of results. Therefore a study was undertaken to determine the effects of various concentrations of water on the gross respiration of soil samples.

EXPERIMENTAL METHODS

The soil samples used were the same as those reported on by Swartz, *et al.* (3), collected from a revegetating field and a virgin prairie. Since it was desired to determine effect of percentage moisture on the respiration of the soil microorganisms, the samples were carefully sieved to remove roots and extraneous matter. Moisture holding capacities were determined for the sieved samples and were found to be 42.6 per cent for the revegetating field and 46.2 per cent for the virgin prairie. These figures are approximately twice as high as the actual field capacities (1) and can be attributed to the change in soil structure as a result of the sieving.

Various volumes of water were added to 2-gram samples of soil in Warburg flasks to give final concentrations of 2, 25, 50, 75, 100, and 150 per cent of the moisture holding capacity. Carbon dioxide evolution was used as a measure of the metabolic activity of soil microorganisms. Standard manometric technics (4) were used with the water bath temperature set at 32° C.

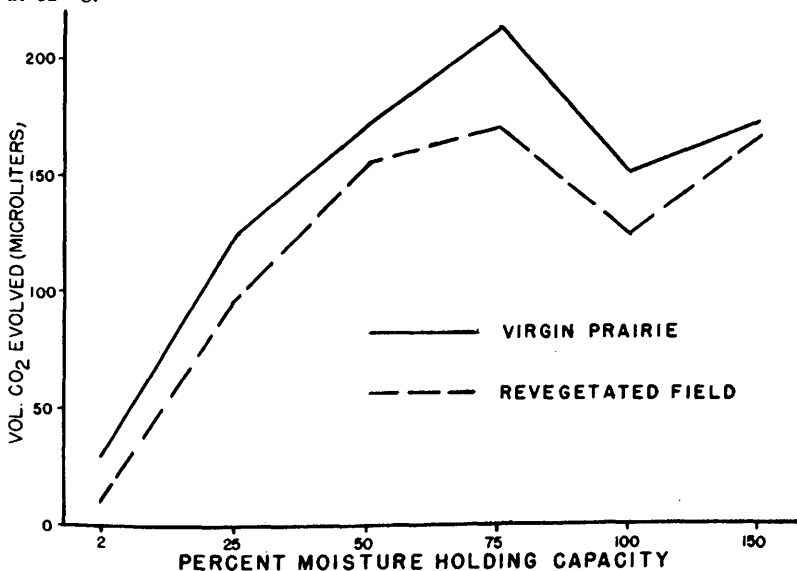


FIGURE 1. Comparison of Amounts of Carbon Dioxide Evolved From Two Soil Samples Using Varying Percentages of Moisture Holding Capacity (13 hour totals).

RESULTS AND DISCUSSION

The effects of various moisture concentrations on the total carbon dioxide evolution over a 13 hour period for the two soil samples is shown in Figure 1. As the amount of water was increased, more food was probably made available for the microorganisms, which would cause a higher metabolic rate. This held true until the moisture concentration surpassed 75 per cent of the moisture holding capacity, at which time the added water created anaerobiosis in the sample and metabolic activity accordingly decreased. When a surplus of water was present, the sample became fluid and the shaking action of the Warburg water bath again created an aerobic condition with a resultant rise in metabolic activity. The necessity of adding the same volume of water relative to moisture holding capacity if an accurate comparison is to be made of the metabolic activity of microorganisms in various soil samples is shown in Figure 1. For example, if a study made on the virgin prairie soil at 100 per cent of moisture holding capacity is compared with a study on revegetating field soil at 75 per cent of capacity it appears that the revegetating field was the more metabolically active, which was not the case.

Figure 2 shows the effects of different concentrations of moisture on carbon dioxide evolution for various total periods of time. The same general pattern is found after the first two readings, thus showing the validity

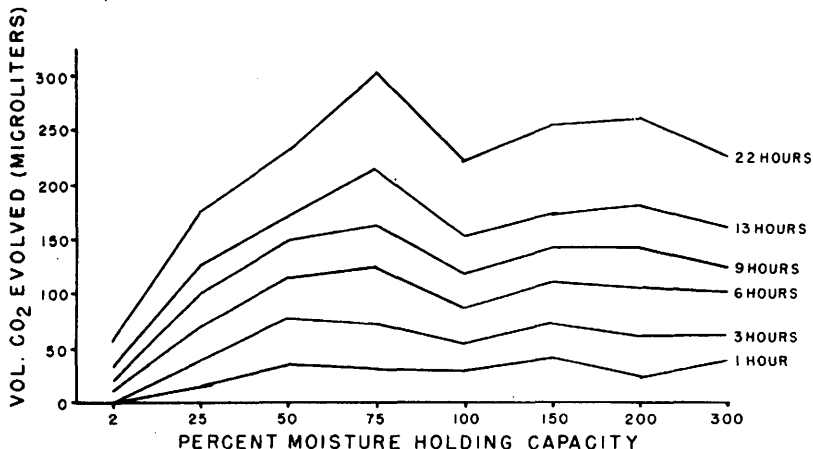


FIGURE 2. Effect of Moisture on Total Carbon Dioxide Evolution of Virgin Prairie Soil.

of results. The readings at one and three hours show some variation, but this could be due to a lag in the activity of certain microorganisms.

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