Effect of some fertilizers and simazine on the activity of the micro-organisms in jack pine humus

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The use of chemicals has become routine in certain phases of forest management in Ontario. Herbicides such as 2,4-D and Simazine are used to control competing vegetation in young conifer plantations. Furthermore, there is, currently, much research underway on the feasibility of increasing fibre production by the use of nitrogen fertilizers. It is important to ascertain what effects additions of such material might have on the humus micro-organisms. As carbon dioxide evolution has long been used as an index of "total microbial activity", we have assumed that any major effect of the applied chemicals will be reflected by a change in this parameter.

Humus samples were collected in September 1968 from a jack pine cutover in Davidson Township of the Englehart Management Unit, Swastika District, in northeastern Ontario (47° 52'N, 80° 22'W). At time of sampling the ground vegetation consisted mainly of blueberry (*Vaccinium myrtilloides* Michx.) and sweet fern (*Comptonia peregrina* (L.) Coult.). Approximately 2 kg of moist humus were collected. The material was well mixed in the moist condition by hand, and stored moist at 5°C for three months before use. This homogenized humus had a loss-on-ignition of 95% (oven dry weight basis) and was quite acid (pH 4.2).

In the laboratory, 50 g (oven dry weight basis) of the moist humus were placed in 250 ml erlenmeyer flasks and connected to Fisher-Milligan gas wash bottles. The CO₂ evolved was measured by absorption in 0.5N NaOH, from which aliquots were titrated to neutrality with 0.1N HCl using phenolphthalein as an indicator, after first precipitating the dissolved CO₂ with excess BaCl₂. Nitrogen was added as Ca(H₂PO₄)₂·H₂O (822 mg/50 g humus = 100 lb/acre nitrogen), and urea (306 mg/50 g humus = 100 lb/acre nitrogen). Phosphorus was added as Ca(H₂PO₄)₂·H₂O (822 mg/50 g humus = 100 lb/acre phosphorus). Simazine was added at a rate of 2.8 mg active per 50 g humus, which equals 2 lb/acre active Simazine.

To obtain data on solubilization of organic carbon, samples of humus (20 g, oven dry weight basis) were treated with various (see Table 1) quantities of NaOH in 100 ml aqueous solution, shaken for 30 minutes and filtered through Whatman No. 1 filter paper in a Buchner funnel under slight vacuum; pH and organic carbon (Walkley-Black) values were determined on aliquots of the filtrate.

TABLE 1. Solubilization of organic carbon from jack pine humus with rise in pH

Milliequivalents of NaOH added per g (oven dry) of jack pine humus	pH of humus extract	Organic carbon (mg/g oven dry humus) in extract
0.000	4.9	0.25
0.014	5.4	0.34
0.034	6.5	1.07
0.065	7.1	2.41
0.113	7.7	4.98
0.189	8.4	9.04

As shown in Figure 1, additions of nitrogen as ammonium nitrate, phosphorus as calcium phosphate or Simazine had no significant effect on the activity of the microbial population. This can be

Fig. 1. Carbon dioxide evolution with time for organic samples treated with various chemicals.

¹Simazine is now distributed in Canada under the registered trade name of "Princeps", the name by which it has been known in Europe and the United States.

taken as evidence that neither nitrogen nor phosphorus were major factors limiting microbial activity. Further, it is evidence that Simazine had no detrimental effect on the activity of the soil population. In contrast, addition of urea resulted in a marked temporary increase of CO₂ evolution. Approximately one half of this increase over the control may be ascribed to CO₂ evolved from the chemical decomposition of the urea itself. The remainder would have been as a result of the oxidation of 1.5 mg of organic carbon per gram of humus. This quantity of carbon would be solubilized by increasing the pH to 6.6 (Table 1).

It has been previously observed that urea has several effects on forest humus. Roberge and Knowles (1966) noted that the addition of urea increased the pH of black spruce (*Picea mariana* (Mill.) BSP) humus from 3.8 to 5.3 in 24 hours and that this increase paralleled the hydrolysis of the urea to NH₄⁺. Subsequently, they observed that this same treatment increased total numbers of bacteria and fungi by 359% and 18.5% respectively (Roberge and Knowles 1967).

We observed (Table 1) that as the pH of jack pine humus was increased by the addition of NaOH, the amount of organic carbon going into solution increased logarithmically. It is reasonable to infer that such material will act as an additional substrate for the microbial population and that the increased rate of CO₂ evolution reflects their increased activities and numbers.

Literature cited

- ROBERGE, M. R. and R. KNOWLES. 1966. Ureolysis, immobilization and intrification in black spruce humus. *Soil Sci. Soc. Amer. Proc.* 30: 201-204.
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