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INFLUENCE OF PLANT PARTS DECOMPOSITION ON THE DECOMPOSITION OF SOIL ORGANIC MATTER

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The addition of fresh plant material to soil has been reported to accelerate the decomposition of indigenous organic matter. In some studies this claim has been disproved. This was tested using ^{14}C labelled tissues of leaves, stems and roots of maize plants of different maturity stages in a laboratory study on a clay loam soil containing 0.49 percent organic carbon. Plant materials added to the soils accelerate the decomposition of indigenous organic matter; plant leaves and stems decompose more rapidly than the roots; increased loss of soil organic matter was obtained in the case of only 14-day old plant materials. Similar trends were observed in case of experiments conducted with moisture for 14 days. Considerably less soil organic matter decomposition was found in a comparable time after the addition of the plant materials in the preincubation experiments than in the non-preincubation experiments.

Development of tracer techniques using ^{14}C, has made it possible to measure the decomposition of indigenous organic matter in soil concurrently with the decomposition of added fresh material. Several reports of such studies (Broadbent and Norman, 1946; Broadbent, 1947; Broadbent and Bartholomew, 1948. Hallam and Bartholomew, 1953; Datta and Goswami, 1962; and Sorensen, 1963) have shown an acceleration in the soil organic matter decomposition rate as a result of fresh plant material additions. Other reports, particularly in the case of organic soils, (Bingeman *et al.*, 1953; Stotzky and Mortensen, 1957) shown no such effect.

Apparently, the addition of plant materials to soils does not always increase the rate of organic matter decomposition. It is desirable to investigate the factors controlling this response in more detail. The investigation reported in this paper concerns the influence of decomposition of plant parts on the decomposition of soil organic matter when the plant materials are incorporated in the soil.

MATERIALS AND METHODS

Labelled plant materials used in this study were obtained by growing maize plants in soil to which $NaH^{14}CO_3$ have been added (Scharpenseel, 1971).

The soil used in this investigation was a clay loam with 0.49 per cent organic carbon and pH 8.1. Some of the soil samples taken up for this study were preincubated in a moist condition for two weeks and some were not preincubated. This dual approach was used because the artificial stimulation of soil micro-organisms that occurs as a result of drying and rewetting soil could affect decomposition of both indigenous and

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Table 1 : Carbon loss and balance from soil incubated with ^{14}C-labelled plant material for 28 days Soil not preincubated with moisture (Mean of two replications)

Plant material added (Maize)	Soil carbon loss (mg)		Soil control C loss minus Soil C loss (mg)
	Control	Plant material added to soil	
7-day old leaves	34	60	- 26
Stems	37	62	- 25
Roots	37	47	- 10
14-day old leaves	37	70	- 33
Stems	37	60	- 23
Roots	37	47	- 10
21-day old leaves	34	46	- 12
Stems	34	46	- 12
Roots	34	42	- 8
28-day old leaves	37	48	- 11
Stems	34	46	- 12
Roots	34	40	- 6

Table 2 : Carbon loss and balance from soil incubated with ^{14}C-labelled plant material for 28 days Soil pre-incubated with moisture. (Mean of two replications)

Plant material added (Maize)	Soil carbon loss (mg)		Soil control C loss minus Soil C loss (mg)
	Control	Plant material added to soil	
7-days old leaves	21	41	— 20
Stems	21	40	— 19
Roots	22	30	— 8
14-days old leaves	22	47	— 25
Stems	21	38	— 17
Roots	21	28	— 7
21-day old leaves	21	30	— 9
Stems	21	29	— 8
Roots	21	27	— 6
28-day old leaves	22	30	— 8
Stems	22	31	— 9
Roots	22	27	- 5

added organic matter. After the pre-treatment of the soil, ^{14}C-labelled plant material was added to the soil and the system was incubated for 28 days. The various ^{14}C-labelled plant materials used were 7, 14, 21 and 28-days-old maize leaves, stems and leaves. Two incubation controls were included, a control for the soil and a control for the ^{14}C-labelled plant material. The soil control (without added plant material) provided decomposition rates of indigenous soil organic matter and the ^{14}C-labelled plant material control (incubated in inoculated sand) provided decomposition rates and specific activity data.

The samples of soils were incubated at room temperature with one per cent additions of the respective plant materials. Moisture content at the beginning of the incubation was at field capacity. In all cases, 50-g samples of the soil, in duplicate, were incubated in 250-ml Erlenmeyer flasks in a closed system. The ^{14}C-CO_2 evolved due to decomposition of plant materials was trapped in 0.5 N NaOH, a suitable aliquot of which after precipitation with $Ba(OH)_2$ was counted in a proportional counting system (Type PCS 15 B of ECIL, Hyderabad).

RESULTS AND DISCUSSION

The conclusions drawn from the present investigation (vide Table 1 and 2) are : Plant materials added to the soils accelerate the decomposition of indigenous organic matter; Plant leaves and stems decompose more rapidly than the roots; Considerably less soil organic matter decomposition is found in a comparable time after addition of the plant materials in the pre-incubation experiments than the in non-preincubation experiments. This, of course resulted from the disappearance of the readily decomposable fraction during the pre-incubation. Increased loss of soil organic matter was obtained in the case of only 14-day old plant materials.

Several reports, as mentioned earlier, have shown an acceleration in the soil organic matter decomposition rate as a result of fresh materials additions and the results of this study corroborate with those. Other reports show no such effect. This is because soils and organic matter differ very markedly in their formation and nature. Joffe (1955), when dealing with the principle of soil zonality, suggested that organic mattter formed in one zone may be significantly different from organic matter formed in another zone. Organic matter formed in the Prairie soils may be more susceptible to decomposition than organic matter formed in the semi-tropical areas. Possibly, green manuring would not reduce the organic matter content of soils in zones where the most resistant soil organic matter is found.

The course of the decomposition depends on the relative rates at which the heat is produced and dissipated in the initial stages, for these determine the temperatures at which the decomposition takes place and hence the composition and activity of the microflora. These relative rates are controlled by the decomposability of the substances, the moisture content and aeration as brought out by this investigation.

Another factor that may be of influence is the relationship of the amount of plant material added to the soil to that already present. In an area where the soil organic matter is readily susceptable to decomposition, the addition of a quantity of plant material that is large in comparison to the organic matter already present may be expected to accelerate the decomposition of the soil organic matter.

The stage of maturity of the added plant material may also influence the decomposition of both the added plant material and the soil organic matter. The results of this investigation bear out this fact.

REFERENCES

BINGEMAN, C.W., J E. VARNER and W.P. MARTIN. 1953. The effect of the addition of organic materials on the decomposition of an organic soil. *Soil Sci. Soc. Amer. Proc.* 17 : 34-38.

BROADBENT, F.E. 1947. Nitrogen release and carbon loss from soil organic matter during decomposition of added plant residues. *Soil Sci. Soc. Amer. Proc. 12* : 246-249.

BROADBENT, F. E. and W. V. BARTHOLOMEW. 1948. The effect of quantity of plant material added to soil on its rate of decomposition *Soil. Sci. Soc. Amer. Proc. 13*: 271-274.

BROADBENT, F. E. and A. G. NORMAN. 1946 Some factors affecting the availability of the organic nitrogen in soil a preliminary report. *Soil Sci. Soc. Amer. Proc. 11* : 264-267.

DATTA, N. P. and N. N. GOSWAMI, 1962. Transformations of organic matter in soil in relation to the availability of nutrients to plants. *Radioisotopes in Soil Plant Nutrition Studies. Proc. of a Symposium. Bombay.*

HALLAM, M. J. and W. V. BARTHOLOMEW. 1953. Influence of rate of plant residue addition on accelerating the decomposition of soil organic matter. Soil Sci. Soc. Amer. Proc. 17 : 365-368.

JOFFE, J. S. 1955. Green manuring viewed by a pedologist. *Adv. in Agron.* 7 : 141—188.

SCHARPENSEEL, H. W. 1971. In : *Soil Biochemistry*. Vol. 2 (A. D. Mc. LAREN and J. SKUJINS, Eds), Marcel Dekker, New York.

SORENSEN, H. 1963. Studies on the decomposition of ^{14}C— labelled barley straw in soil. *Soil Sci. 95*: 45—51.

STOTZKY, G. and J. L. MORTENSEN. 1957. Effect of crop residues and nitrogen additions on decomposition of an Ohio muck. soil. *Soil. Sci. 83;* 165—174.