DECOMPOSITION AND HUMIFICATION OF PLANT RESIDUES BY SOME
SOIL FUNGI

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SUMMARY: Decomposition and humification of powdered plant material
of Leptochloa fusca L. Kunth and Sesbania aculeata Pers. by eight soil
fungi was studied in pure culture. Maximum decomposition was caused
by Sporotrichum pruinosum, and maximum humification by Stachybotrys
atra. Significant differences were observed in some chemical and optical
properties of humic compounds produced by these fungi.

INTRODUCTION

Organic amendment is a recognized method for improving soil produc-
tivity and has been recommended for the amelioration of salt-affected
soils (Yadav and Agarwal, 1961; Sandhu and Malik, 1975). Such soil
are, however, poor in microbial population, resulting in a low rate of
organic matter decomposition. Inoculation of such soils with appropriate
microbes or addition of decomposed plant residues may be necessary for
the desired effects.

The present investigation was aimed at studying the role of fungi
in decomposition and humification of plant residues. The fungi used
were previously reported highly salt-tolerant and efficient cellulose
decomposers (Malik et al., 1982). Some of these species e.g. D. rostrata,
Papulospora sp. and S. atra, form dark coloured phenolic polymers
called "melanins" which are either incorporated into their mycelia or
secreted into the growth media. Melanins have been reported to participate
in soil humus formation (Haider et al., 1974). The substrates used for
their growth were L. fusca (Lf) and S. aculeata (Sa); the former is a
highly salt-tolerant grass while the latter is a moderately salt-tolerant
forage legume. Both the grass and the legume have been proposed by
Sandhu and Malik (1975) as primary and secondary colonizers, respec-
tively, of salt-affected soils. These substrates were chosen for the study
as they can be obtained in bulk quantities from such soils for the large
scale production of an organic manure.
MATERIALS AND METHODS

Fungi in the study were isolated from salt-affected soils of Pakistan and included: Aspergillus sydowi, A. terreus, Chaetomium globosum, Drechslera rostrata, Papulospora sp., Sporotrichum pruinosum, Stachybotrys atra and Trichoderma piluliferum. Four g. powdered plant material of Lf grass or Sa legume was taken in 50 ml Erlenmeyer flasks, moistened with 12 ml distilled water and autoclaved. The flasks were inoculated with 4 mycelial discs (10 mm) cut from actively growing margins of fungal colonies grown on malt extract agar medium. Each treatment was in triplicate. Inoculated flasks were incubated for 4 weeks at 30°C and shaken by hand at weekly intervals. After incubation the material was dried at 70°C to a constant weight and the loss in weight calculated. Portions of the air-dried material were extracted with 0.2N NaOH (one hr shaking at room temp.) followed by filtration through Whatman No.1 filter paper. An aliquot of the alkali extract was acidified to pH 2.0 and incubated at 80°C for 30 min. The precipitate (humic acid) was isolated by centrifugation and dissolved in 0.1 N NaOH. Carbon content of the alkali extract (humic acid + fulvic acid) and humic acid were determined by colorimetric method (Malik et al., 1979). The amount of humic compounds was calculated by multiplying C content by 1,724 (Kononova, 1966). Humification productivity i.e. ratio of humus produced to C lost (as CO₂) (Franklova and Novak, 1967) was also calculated. Nitrogen content of humus fractions was estimated by micro-Kjeldahl (Bremner, 1965). Optical density of humic acid was taken at 465 and 665 nm to obtain E₄/E₆ ratio.

Lignin content of the organic material was determined by an acid hydrolysis method (personal communication, K. Haider, FAL, Braunschweig, FRG). Samples used for this purpose were first extracted with 0.2 N NaOH to avoid co-precipitation of humic compounds during acid hydrolysis. Concentrated HCl (12.5 ml) was added to 250 mg of alkali extracted material in 100 ml Erlenmeyer flasks. The flasks were stoppered and after 15 min. 1.25 ml conc. H₂SO₄ was added. The flasks were stoppered again and shaken for 12 hrs on a rotary shaker. After shaking, the volume was made up to 250 ml with boiling water and the flasks kept in boiling water for 10 min. The contents were filtered through a pre-weighed sintered glass crucible and washed repeatedly with hot water until pH of the filtrate was neutral. The residue (lignin) was dried at 105°C to a constant weight.

RESULTS

As judged by loss in weight of the substrate, S. pruinosum caused maximum mineralization of both substrates i.e. 33 and 45% for the grass and the legume, respectively (Table 1). The remaining fungi mineralized only up to 21% of the two substrates. A. terreus a highly efficient decomposer of filter paper cellulose (Malik et al., 1982), was found to be the least efficient. On the other hand, melanoid fungi namely, D. rostrata, Papulospora sp. and S. atra, with relatively low cellulase activity (Malik et al., 1982) proved better decomposers of both the substrates. Regarding the comparative utilization of the two substrates more weight