Acta Botanica Indica 14 (*Spl.*) : 1–5, 1986

STUDIES ON DECOMPOSITION OF PADDY (*ORYZA SATIVA* L.) LITTERS WITH FUNGI UNDER LABORATORY CONDITIONS

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Rate of decomposition and change in chemical composition of paddy straw and root litters were studied under laboratory conditions using two dominant litter fungi, *Mucor racemosus* and *Fusarium moniliforme*. The rate of weight loss was higher in the set inoculated with mixed cultures than the ones inoculated with pure cultures. Quantitative changes in cellulose, hemicellulose, lignin, sugar and total nitrogen were governed by fungal species. In general, decomposition of root was slower as compared to the straw.

Fungi are the primary and major decomposer of plant materials in soil. They utilize the bond energy of organic molecules and release minerals which are locked up in plant litters. Composting of paddy straw and roots by inoculating different microorganisms may help in their disposal and also augmenting the soil organic matter resources. The present study was undertaken to see the efficacy and role of certain dominant litter fungi in the process of decomposition of paddy litters.

MATERIALS AND METHODS

Two g of oven dried paddy straw and roots were placed in a 500 ml conical flask and moistened with 20 ml of distilled water. The flasks were autoclaved at 15 lb pressure for 20 minutes. Pure cultures of *Mucor racemosus* and *Fusarium moniliforme* were isolated on Czepek's nitrate sucrose medium (Johnson and Curl 1972) from decomposing paddy litters. 20 agar blocks of 5 mm diameter cut from periphery of 7-day old culture were transferred to the flask. In the mixed set, 10 blocks of both the fungi were added. In the control set only the agar blocks were put without fungi. The flasks were cotton plugged and incubated in BOD incubator at 25$\pm$1°C. After an interval of 15 days the moisture content of litter was adjusted with sterile distilled water to the original level. The experiment was conducted for a period of 329 days. The weight loss and change in chemical composition of litter were analysed periodically by harvesting three flasks from each set. First four harvest were made at monthly interval

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and subsequent from 50 to 100 days intervals. After harvesting, the litter was dried in a hot air oven at a temperature of 60°C until a constant weight was recorded. The percentage weight loss of litter was calculated on the basis of oven dry weight of sample. Cellulose, hemicellulose were estimated by Jermyn's (1955) method and lignin by the method described by Fruedenburg (1955). Total sugar was determined following Mahadevan and Sridhar (1982). Nitrogen was estimated by the Kjeldahl digestion method. Three replicates were analysed for each sample and values are means. Olsen's (1963) exponential decay mo el was used for calculations of rate of decay (k), half life and 95% life periods.

RESULTS

Rate of Decomposition

In general, the rate of weight loss of paddy straw was faster when both *F. moniliforme* and *M. racemosus* were inoculated. Table 1 shows the decay

TABLE I. Decay rate constant (k), half life and 95% life of paddy straw and root decomposition under laboratory condition.

Litter type	Treatments	Rate of decay	Half life (days)	95% life (days)
Paddy straw	*Fusarium moniliforme*	0·0083	834·940	3614·458
	Mucor racemosus	0·008	787·500	3409·091
	Fusarium moniliforme + *Mucor racemosus*	0·0098	707·143	3061·225
Paddy root	*Fusarium moniliforme*	0·0083	834·940	3614·458
	Mucor racemosus	0·0083	834·940	3614·458
	Fusarium moniliforme + *Mucor racemosus*	0·0084	825·000	3571·429

rate (k), half life and 95% life values as calculated from Olson's (1963) exponential decay model. *F. moniliforme* was equally effective for both type of litters whereas *M. racemosus* decomposed straw at afaster rate than root litter. In general, the decomposition of root was slower than straw (Fig. 1).

Cellulose, Hemicellulose, Lignin, Sugar and Nitrogen

The cellulose content of decomposing straw and root declined steadily in all the sets. However, the rate of drop and absolute values at the end of the experiment differed depending on the type of litter and species of fungi inoculated. Maximum decline occurred in straw inoculated with mixed cultures. The percentage hemicellulose content also dropped to a significantly low level. The

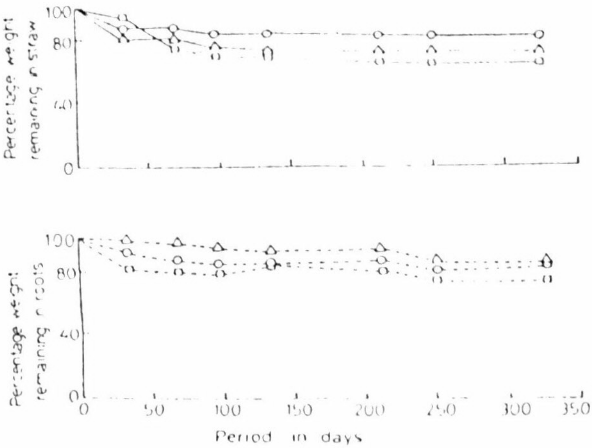

Fig. 1. Percentage weight remaining of paddy straw and root litters during decomposition. Circles—*Fusarium moniliforme*; triangles—*Mucor racemosus*; squares—*Fusarium moniliforme* + *Mucor racemosus*.

decomposition of hemicellulose was not influenced by the type of litter and species of fungi (Fig. 2). The percentage lignin of litter remained fairly stable. In general, straw contained higher percentage of lignin than roots. Relatively higher decrease in percentage lignin was observed in mixed cultures. However, the differences among the fungal treatments were insignificant (Fig. 2). In general, sugar content of both litters decreased with time. Nitrogen content in the decomposing paddy root was always higher than straw. Higher nitrogen content was recorded in both straw and roots inoculated with mixed cultures.

DISCUSSION

In laboratory studies where moisture, nutrient and temperature were not limiting the rate of decomposition is faster during initial periods, however, it declines when half the litter is lost. The reason being accumulation of fungistatic and/or fungitoxic substances (Brown and Dicky 1970; Crawford *et al.* 1977; Schroder and Gewehr 1977). The differential dry weight loss of litter under laboratory conditions indicated that different fungal species have different decomposing ability under similar conditions. According to Parnas (1975) the rate of decomposition of any substrate is generally potential to the growth rate of its decomposers. The variation in percentage loss of different litter components suggests that the rate of decomposition is closely linked with the activity of organisms involved in the process of decomposition. William and Gray (1974) stated that the rate of decomposition is affected by external factors such as temperature, moisture and internal factors such as chemical composition of the material. The steep loss in weight during initial phase might be due to the faster breakdown of simple organic compounds from the litters by the fungi.

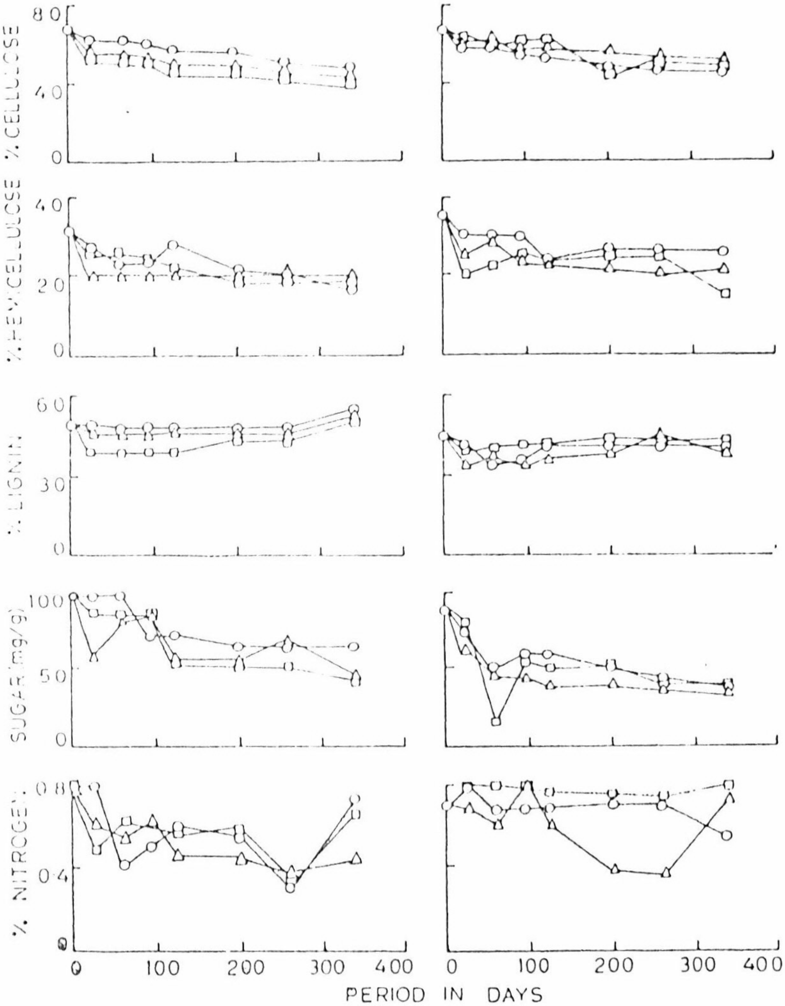

Fig. 2. Changes in chemical composition of paddy straw and root during decomposition. Circles—*Fusarium moniliforme*; triangles—*Mucor racemosus*; squares—*Fusarium moniliforme* + *Mucor racemosus*.

Accumulation of refractory materials (e.g. lignin) and subsequent slower breakdown of these materials might be an important cause for the slower rate of weight loss during later part of the study. Paddy straw inoculated with both *Fusarium* and *Mucor* showed speedier loss of cellulose than the other two sets. The total sugars decreased gradually in both straw and roots where *Fusarium* and *Mucor* were inoculated. The increase in sugar content during later periods may be accounted to the microbial degradation of complex carbohydrates into sugars. The increment in nitrogen content of paddy straw was observed in *Fusarium* and mixed culture inoculated sets. The increment in nitrogen content during the process of decomposition was also reported by Suberkropp *et al.* (1976) and Tiwari and Mishra (1983) and they attributed immobilization of nitrogen to the microbial biomass as significant cause. Rai and Srivastava (1983) concluded that colonization and decomposition potentiality of individual fungi is governed by their enzyme system and the chemistry of the litter.

The maximum loss in weight was observed when both *M. racemosus* and *F. moniliforme* were inoculated. This may possibly be due to the presence of more degradative enzyme in the mixed cultures. Decomposition of paddy straw was little faster than roots as straw has larger surface area for the microbial attack and roots have very hard surface which resist microbial activity. The variation in the percentage loss of different chemical components depending on the fungal species inoculated suggests that the rate of decomposition is closely linked with the activity of fungi.

Authors are thankful to the Council of Scientific & Industrial Research, New Delhi for financial assistance.

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