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Rice straw decomposition in rice-field soil

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Abstract

Rice straw, buried in a rice-field during the dry season decomposed at a rate of 0.0075 day-1. Seventy five percent of the biomass, 70 percent carbon, 50 percent nitrogen and 30 percent phosphorus remained after 139 days of decomposition. Rice straw decomposition furnished 33% N and 8% P of the total nitrogen and phosphorus provided by man.

Introduction

Burying rice straw after harvesting is a common practice carried out to increase the nutrient contents of the soil. However not many studies on rice straw decomposition are available (Acharya, 1935).

This paper presents information on the release of the carbon, nitrogen and phosphorus during the dry season of the rice cultivation period from rice straw buried in the soil. Nutrient contribution in rice-fields is also discussed.

Materials and methods

Rice plants were collected just after harvesting from a rice-field of the Ebro Delta (N.E. Spain). Rice shoots and leaves were cut into short pieces of about 6 to 8 cm long. Samples of fresh material, each equivalent to 2.6–4.7 g dry wt, were buried in the soil inside nylon bags of 2 mm mesh size. Triplicate samples were selected 1, 3, 15, 30, 60, 120 and 139 days after burying, and analyses for dry weight, ash, total carbon, nitrogen and phosphorus were made from duplicate portions of each sample.

Results

Changes in the rice straw biomass during the decomposition process are shown in Fig. 1. Fifty-eight percent of the initial weight was lost after 139 days burial. The instantaneous decomposition rates, k, (Olson, 1963) for the rice straw was 0.00775 day-1 with a tm equal to 89 days. Ash percentage increased with time. It became 17.7% to 21.2% of the total rice detritus weight.

Carbon, nitrogen and phosphorus contents of the rice straw during the decomposition process are shown in Fig. 1. Nutrient loss rates followed roughly the order N < C < P. Consequently, a relative nitrogen enrichment occurred with time. Nutrient release was faster during the first fifteen days, particularly for phosphorus.

Discussion

Rice straw decomposed slower than submerged macrophytes (Howard-Williams and Davies, 1979). The decomposition rates were closer to those of terrestrial plants such as *Quercus alba* or *Carya glabra* (Suberkropp *et al.*, 1976), because they have a wall which incorporates a high mineral content slowing down the decomposition process (Bastardo, 1979). Rice shoots and leaves in the last growing stages had a low nutrient contents with C:N ratio higher than 20–30:1 (Forès and Comin, unpublished data). In this case, a clear trend for the decomposition rate to decrease was observed (Gosz *et al.*, 1973).

Rice straw decomposition during the time while

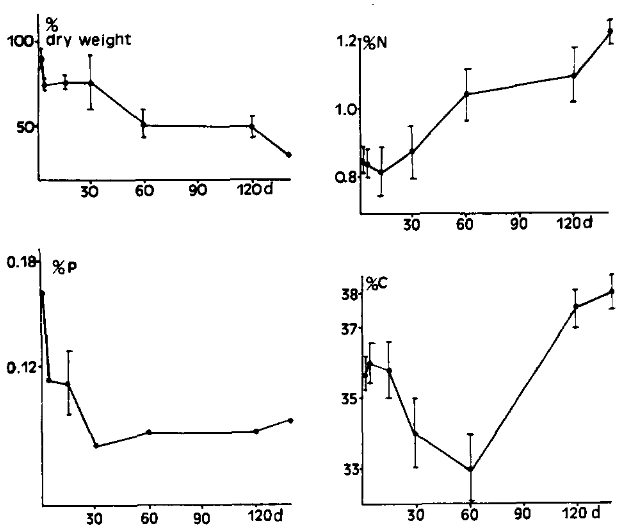

Fig. 1. Remaining biomass percentage during the rice straw decomposition process (**a**), percentages of total dry weight as phosphorus (**b**) nitrogen (**c**) and carbon (**d**).

rice-fields remain dry supply nutrient to the soil. They can be considered as part of the available nutrient for the next cultivation-flooded season. These contributions are as much as 33.3% and 8.4% of N and P respectively, on the total amounts of N and P supplied by man as chemical fertilizers (62.05 kg N ha^{-1} and 20.29 kg P ha^{-1}). However 1.75 kg N-NO_3 ha^{-1} and 5 g N-NH_4 ha^{-1} are released from the soil to the water column during the first hours after flooding (Fores and Sabater, 1987).

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