Bulletin of Japanese Society of Microbial Ecology
Vol. 5, No. 1, 25-27, 1989

ISME-5 ← comes

Round table: Microbial processes in paddy fields

Pierre Roger

The International Rice Institute, P.O. Box 933, Manila, Philippines

The round table on "Microbial process in paddy fields" was held from 1900 to 2100 hrs on August 28. The session was chaired by Dr. I. Watanabe. After the introduction of the participants (list annexed), Dr. Watanabe indicated that the session was intended for an informal exchange of ideas and opinions. He proposed to start the round table with a brief introduction on N cycle in wetland ricefields, then to place emphasis on (1) microbial biomass in ricefields, (2) denitrification, (3) methane production, and finally to discuss other topics of interest to the participants.

After a brief summarization of the beneficial effects of flooding on rice soils fertility, Dr. Roger presented IRRI's work on the role of the photosynthetic aquatic biomass (algae and aquatic plants) on soil processes. He summarized recent estimates of C and N inputs by this biomass (including photodependent biological N_2 fixation) and their contribution to the maintenance of microbial biomass and available N in soil. Data in 1988 show that suppressing photosynthetic activ-

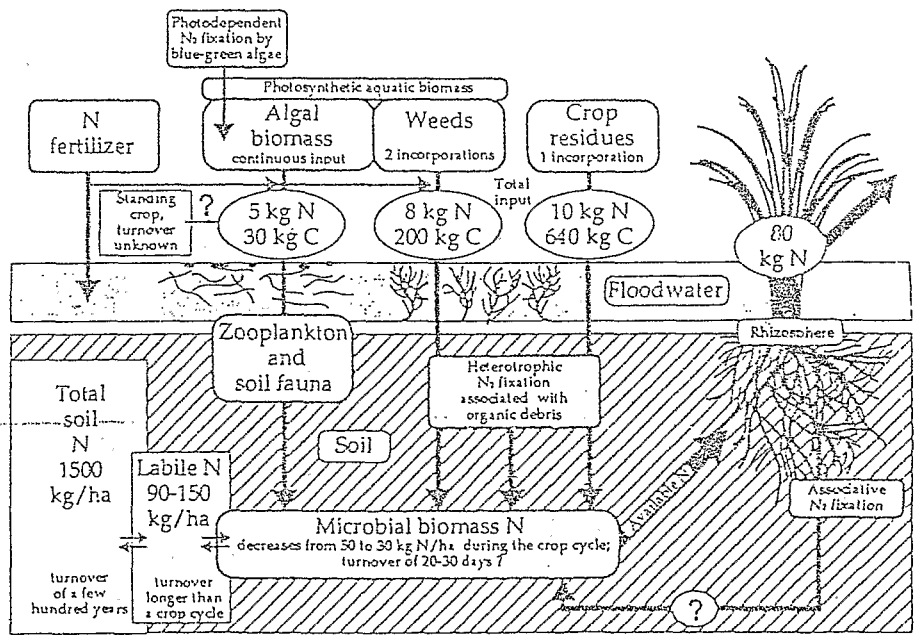

Fig. 1. Conceptual scheme of the pathways involved in the replenishment of soil microbial biomass in wetland ricefields.

ity in floodwater led, during the first year, to an average decrease by 20-25% of soil microbial biomass (N fisuh). Dr. Roger ended his presentation with a conceptual scheme of the role of soil microbial biomass in wetland soil fertility and the pathways involved in its replenishment (Fig. 1). Dr. Watanabe commented on the key role of soil microbial biomass for rice production. Most of the N absorbed by the rice plant comes from the soil and adequate methodologies are needed for estimating microbial biomass in wetlands.

Methodological aspects of microbial biomass quantification were presented by Dr. Brookes and Dr. Inubushi who reported the results of a laboratory study comparing fumigation-incubation (FI), fumigation-extraction (FE), and ATP to estimate microbial biomass C in an upland temperate soil and a wetland temperate rice soil. Both soils were unplanted. Under aerobic conditions biomass C estimated by FI, FE, and ATP changed little during an 80-day incubation period and were closely correlated. But when soil was waterlogged, biomass C estimated by FE decreased by 10-40%. ATP also decreased and the decrease had a faster rate than that of biomass C. Dr. Brookes indicated that changes in the total pool of adenine nucleotids (ATP+ADP+AMP) more closely followed the decrease in biomass C estimated by FE as compared with ATP. Adenylate energy charge [(ATP+0.5 ADP)/(ATP+ADP+AMP)] decreased from 0.75 to 0.34 during anaerobic incubation of upland soil and from 0.75 to 0.54 in rice soil. It was concluded that FI is unsuitable for measuring biomass C in waterlogged soil. Biomass N can be estimated by FE but the conversion factor needs to be examined.

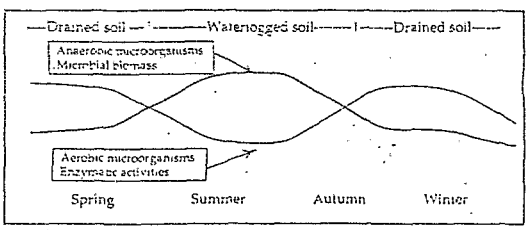

Fig. 2. Schematic representation of seasonal changes of microbial counts, microbial biomass, and enzymatic activities in rice rhizosphere.

Dr. Inubushi also summarized his early studies — done at IRRI with Dr. Watanabe — on changes in microbial biomass in three soil types during a crop cycle. This work, with ^{15}N-labeled soil, quantified soil microbial biomass and showed that during the second part of the crop cycle, N absorbed by the rice plant came from the soil and had an isotopic composition close to that of microbial biomass.

The participants discussed how a rapid turnover of microbiomass N in paddy soils is possible despite the apparently low activity shown in adenylate energy charge. Dr. Watanabe pointed out that the rapid turnover in tropical ricefields may be due to temperature and water saturation. Dr. Jariya Boonjawat pointed out that anaerobic conditions may stimulate ammonium excretion.

Dr. Kanazawa then presented the results of a study of enzymatic (hydrases) activities in the rhizosphere of rice. Results showed a decrease of all tested activities under waterlogged conditions, while microbial biomass and ATP content increased (Fig. 2). The discrepancy between these results and those of Drs. Brookes and Inubushi can be explained by a replenishment of soil microbial biomass by the rice rhizosphere and the photosynthetic aquatic biomass in the field samples used by Dr. Kanazawa. The methods of ATP extraction used by Dr. Kanazawa and Drs. Brookes and Inubushi were also different.

Dr. Watanabe pointed out that, whereas direct methods for estimating total N losses (^{15}N balance) and N losses by ammonia volatilization (micro meteorological method) are available, there is still no satisfactory method for direct measurement of N losses by denitrification. None of the participants could suggest a new approach, or an improvement of existing methods, for such measurements.

Dr. Knowles presented data showing evidence for methanotrophic nitrification in an organic soil.

A mixed bacterial consortium, obtained from a humisol and incubated with methane and ammonium, showed nitrite production during methane consumption. This was followed by nitrate formation. Dr. Knowles concluded that such interactions could occur in certain aquatic and terrestial ecosystems.

Dr. M. Kimura presented an electron microscope study of the microbial colonization of the rice rhizoplane and its decomposition by bacteria. Different patterns of colonization and decomposition were observed for (1) the sites of lateral root emergence, (2) the young roots with mucigel and hairs, and (3) old roots with precipitated ferric hydroxide cover.

* * *

Name	*Organization*	*Interest*
Jariya Boonjawat	Chulalongkorn Univ.	N_2 fixation in rice rhizosphere
Phil Brookes	Rothamsted, UK	Soil microbial biomass
S. Chaudhuri	West Bengal Agric. Univ. India	Rice culture, N_2-fixation by root association
Tse-shu Chien	Zhejiang Agric Univ.	Soil microbiology and microbiology of methane fermentation
Choseki Furusaka	Tohoku University	Distribution & chemical activity of soil microorganisms
T. Gamo	NIAR, Japan	N_2-fixing bacteria
K. Inubushi	MIE University	Microbial biomass in soils
Makoto Ishimoto		Sulfate reducers and anaerobes
Eisuke Kikuchi	Tohoku University	Effects of soil macroorganisms on microbes and soil chemistry
S. Kanazawa	Univ. Tokyo	Enzymatic activities in rhizosphere
M. Kimura	Nagoya Univ.	Rhizosphere. Denitrification in phycosphere....
Roger Knowles	Macdonald College of McGill Univ. Canada	N metabolism & methanotrophs
J.A. Ocio	Rothamsted. UK	Soil microbial biomass
Hiroshi Oyaizu	Toyama University	N_2-fixing bacteria
Pierre Roger	IRRI	N cycle and photosynthetic aquatic biomass in ricefields
Masonori Saito	Tohoko Nat. Agric. Stn.	VAM, soil fertility, ect.
Motoaki Tojo	Osaka Pref. Univ.	Ecology of soil borne pathogen
Koki Toyota	Nagoya University	Ecology of soil microorganisms.
Iwao Watanabe	IRRI	N_2 fixation
Mitsuo Watanabe	Kyoto Pref. Univ.	Ecology of soil micropathogen
Jinshui Wu	Rothamsted. UK	Biomass C and O turnover