Managing C and N for sustaining soil quality and productivity of rice in rice-rice and rice-wheat systems.

Agnes Tirol PADRE DOST - 10221

Associate Scientist,
CESD, International Rice Research Institute

Japanese Advisor : Kazuyuki INUBUSHI
Professor, Chiba University

The impacts of the combined use of inorganic and organic fertilizers with enhanced biological nitrogen fixation (BNF), in improving or maintaining soil fertility, soil quality and productivity of rice were studied. The N contribution of an N_2-fixing algal bloom in the rice field was estimated at 13-25 kg N ha^{-1} while heterotrophic and rice plant-associated BNF was estimated at 1-5 kg N ha^{-1} $crop^{-1}$. It was shown by pot and field experiments that 27 to 36% of BGA-^{15}N was available to the first and second crops. Moreover, after 2 crops, 57% of ^{15}N from BGA as compared to 30-40% of ^{15}N from ammonium sulfate remained in the soil suggesting that algal N is less susceptible to losses than mineral fertilizer. Straw application supported heterotrophic and plant-associated BNF. Moreover, BNF per plant was either enhanced or not affected by the application of inorganic N and organic manures and the effect was proportional to the plant biomass. Rice varieties with higher ability to stimulate BNF and improved N utilization efficiency were observed in field screening trials. The development and preferential planting of such varieties would help reduce N input requirements.

An integrated analysis of rice yield data from rice-rice (RR) and rice-wheat (RW) long-term experiments (LTE) in Asia showed a declining trend with only inorganic fertilization and a positive trend when combined with farmyard manure (FYM). However, the initial yield was generally lower with FYM than without, that a yield increase due to FYM was observed only after 15 years. Soils from 3 RW LTE in Fukuoka, Japan (40y), Ludhiana, India (20y), and Bhairahawa, Nepal (15y), with continuous applications of organic manure (rice straw, wheat straw, rice straw compost,

green manure, or FYM) combined with inorganic fertilizers (NPK) were analyzed for changes in soil chemical and microbiological parameters relative to unfertilized and inorganically fertilized controls. Addition of organic manures especially rice straw compost and FYM, which had the most accumulation of total C and N in the soil, showed improvements in soil chemical and microbiological properties over the controls. In Ludhiana, total C was increasing or was stable over the years but decomposable C and total N were decreasing except in the FYM treatment. Results indicate that inorganic fertilization alone cannot maintain soil quality and sustain productivity. Development of optimized but sustainable organic-supplemented fertilization strategies is needed.