EFFECT OF INTERCULTIVATION ON NITROGEN DYNAMICS IN PADDY FIELD UNDER SUBMERGED CONDITION

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Weed Management is an important component of crop production as elimination of weeds is hard to achieve. Though use of herbicides has become popular in developed countries, many farmers in poor countries lack access to the chemicals due to economic reasons. Mechanical weed control, using rotary weeder employed as secondary tillage into the surface soil, is more practical in rice cultivation where it is planted in straight rows. Benefit of intercultivation may be related to mechanical effects on soil structure aeration and water content; tillage is generally known to affect these soil factors, thereby influencing crop growth. In hypothesis of this study, therefore, intercultivation may contribute to incorporation of microbial biomass as well as that of weed biomass into the surface soil, and then supplies additional nitrogen (N) biomass that can later be mineralized as plant available N forms. As a result, adequate plant available N may favor for rice growth. The objective is thus to study the effect of intercultivation, phosphorus (P) fertilizer application and their interaction on soil N fertility and rice growth under submerged condition.

Materials and Methods: ⑵ A preliminary experiment was conducted at Yamagata University Farm in 2009 by using the seedlings of rice (cv. Sasanishiki) with the spacing of 30 cm × 15 cm transplanted in 12th May. ⑶ There are four treatments plots; 1) 0 times intercultivaiton under herbicide application, 2) 0 times without herbicide, 3) 4 times without herbicide, and 4) 8 times without herbicide. ⑷ Two layers (0-3 cm and 5-10 cm depths) of soil profile were collected every sampling dates at three spots randomly in each plot. Any plant sample was not collected in this preliminary experiment. ⑸ In 2010, the same rice variety was transplanted with the spacing of 30 cm × 15 cm in 19th May at Yamagata University farm. ⑹ The four treatments consist of 1) control, 2) phosphorus (P) fertilizer application, 3) intercultivation, and 4) intercultivation with P fertilizer application. Randomized complete block (RCB) design was used with 4 replications. ⑺ The first soil sample was collected two days after transplanting. Surface soil (0-3 cm) and plant samples were collected at each growth stages; mid-tillering (MT), panicle formation (PI), heading, and maturity. ⑻ Net and Gross N mineralization of surface soil were analyzed by the use of ^{15}N dilution approach with incubation method in either 2009 or 2010. ⑼ Plant physical parameters were also measured. ⑽ Kjeldahl method was used for the analysis of soil organic N and plant accumulated N.

Results and Discussion: ⑴ In the preliminary experiment 2009 study, although the amount of existing exchangeable NH_4^+-N was not much different between upper and lower soil layers, the quantification of gross and net N mineralization become considerably higher in upper surface soil layer than in lower soil layer after incubation. ⑵ Either 4 times or 8 times intercultivation treatments had low N mineralization in the upper soil layer at around mid-tillering stage. ⑶ It might be expected that intercultivation might be obstructed N mineralization during mid-tillering periods. ⑷ Immobilized N % derived from ^{15}N fertilizer after incubation was opposite to mineralization, i.e., it was little higher in lower soil layer than in upper soil, particularly during mid-tillering to panicle formation stage. ⑸ It might be suggested that according to microbial biomass distributed into the flooded water and surface soil in the rice field providing lower carbon-nitrogen ratio in the upper thin surface soil layer than that in the lower soil layer. ⑹ In 2010, as same as in 2009 study, gross and net N mineralization of control was higher than those of intercultivation treatments, particularly at mid-tillering stage, but those differences were not statistically significant. ⑺ Soil organic N became significantly increased from the period after transplanting to the period of harvest time except P application treatment. ⑻ Net/gross ratio is significant higher in P application treatment at heading stage, leading to low N fertility in long-term. ⑼Plant height and total dry matter were also not significant different statistically among the treatments. ⑽ It was found that an interaction between intercultivation and P application was statistically significant in SPAD value measurement after heading. ⑪ But the plant N uptake and the yield were not significantly different although control had the lowest.

Conclusion: Although the differences might be because of a bit stabilized decomposition rate of soil organic nitrogen by intercultivation, it was negligible because of no statistical significance. Intercultivaiton would have positive effect on fate of Nitrogen, and growth and yield of rice because some results indicated significant higher differences. P fertilizer application may not be suitable under no intercultivation as it show higher value in Net/gross ratio. According to significant interaction between intercultivation and P application at SPAD value, their combined effect should be taken into consideration. Therefore, long-terms continuous studies should be appreciated to assess the N fertility by the intercultivation and Phosphorous application.