Fate of Nitrogen Derived from Organic Materials Applied to Paddy and Converted Upland Fields : Results of the First Year Experiment

Fate of Nitrogen Derived from Organic Materials Applied to Paddy and Converted Upland Fields -Results of the First Year Experiment-

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Paddy-upland rotation, alternating between a rice paddy field and an upland field every few years, is one of the cultivation system practiced for sustainable agriculture in Japan. Recently, decrease in soybean yields due to decrease in soil fertility in converted upland fields have been reported in northern Japan. Organic materials application to fields is important to maintain the soil fertility of rotated paddy fields. Quantification of the distribution of nitrogen (N) derived from organic materials (plant uptake or remaining in soil) is required to determine the appropriate amount of organic materials application. The aim of this study is to evaluate the fate of N derived from organic materials in paddy-upland rotation for a long term by ^{15}N-tracer method. In the first year experiment, we considered the fate of N derived from organic materials applied to paddy and upland fields.

In 2012, microplot experiment was conducted in a paddy and a converted upland field at the Center of Field Education and Research, Akita Prefectural University, Ogata, Akita, Japan (N40°00', E139°50', -3 m a.s.l.). Polyvinyl chloride frames (17 cm × 30 cm, height 25 cm) were put into the both fields. Fresh soil previously collected from a plow layer in a paddy field (soil type: gley lowland soil) was well mixed with ^{15}N-labeled hairy vetch (HV: *Vicia Villosa* Roth cv. Kantaro) cattle manure compost (CMC) or chemical fertilizer (ammonium sulfate: AS) was put into the frame. The application rates of HV was 6 and 15 g N m^{-2} for the paddy and upland, respectively, CMC was 20 g N m^{-2} for both the paddy and upland, and AS was 6 and 2 g N m^{-2} for the paddy and upland, respectively. After puddling, three rice plant seedlings (*Oryza sativa* L., cv. Akitakomachi), were transplanted at the center of each paddy microplot. A soybean plant (*Glycine Max* (L.) Merr. cv. Ryuho) was cultivated in each upland microplot. Aboveground parts of the rice and soybean plants were harvested at 109 d after transplanting and 93 d after sowing, respectively. At the same time, the soils inside the frames were also collected. The plant and soil samples were ground into a fine powder after drying and then determine ^{15}N concentrations. The distribution of N derived from HV, CMC and AS were calculated on the basis of the ^{15}N results.

In the paddy field, the rate of N derived from the materials uptake by rice plants decreased in the order of AS (51%), HV (37%) and CMC (5%). The rate of N remained in the soil was the highest in CMC (66%) followed by HV (34%) and AS (27%) in the upland field. The rate of N uptake by soybean plants decreased in the order of HV (26%), AS (24%) and CMC (3%). The rate of N remained in the soil was highest in CMC (74%), followed by HV (66%) and AS (34%). From the results, although the rate of N uptake by soybean plants of HV were similar with AS, N derived from HV remained in the soil especially in the upland field. Therefore, HV application is expected to supply N efficiently for plants and soils especially in upland fields. CMC application is expected to maintain and increase the soil fertility in both paddy and upland fields.