INTISARI

Simpanan C dan N-tanah dalam bentuk C-total dan N-total, yaitu dalam bentuk organik maupun anorganik. Fraksi C dan N juga ditemukan di atmosfer, yaitu gas CO_2, CH_4, CO dan N_2O. Gas rumah kaca (GRK) yang utama yaitu CO_2, CH_4 dan N_2O. Budidaya padi dapat mengemisikan gas-gas tersebut. Lahan sawah memegang peranan penting dalam mitigasi gas CH_4 dan N_2O. Penelitian ini bertujuan 1) Mengetahui karakteristik, morfologi dan klasifikasi tanah di lahan sawah irigasi pada beberapa pola rotasi tanaman, 2) Mengetahui pertumbuhan dan produktivitas padi Inpari 23 dan Mentik Wangi pada beberapa pola rotasi tanaman, 3) Mengetahui laju dekomposisi seresah di lahan sawah irigasi selama pertanaman budidaya padi sawah pada beberapa pola rotasi tanaman, 4) Mengetahui distribusi fraksi C dan N tanah sawah pada beberapa pola rotasi tanaman, dan 5) Mendapatkan besarnya emisi GRK yang dihasilkan dari budidaya padi sawah irigasi pada beberapa pola rotasi tanaman. Penelitian ini dilakukan dengan tiga tahapan penelitian, yaitu: Tahap I : Karakteristik, morfologi, dan klasifikasi tanah sawah irigasi pada beberapa pola rotasi tanaman. Tahap II : 2(a). Dinamika pertumbuhan dan produktivitas padi selama dua musim tanam di lahan sawah irigasi pada beberapa pola rotasi tanaman, dan 2(b). Laju dekomposisi seresah di lahan sawah irigasi selama pertanaman budidaya padi sawah pada beberapa pola rotasi tanaman. Tahap III : 3(a). Distribusi vertikal dan horizontal fraksi C dan N tanah sawah irigasi pada beberapa pola rotasi tanaman, dan 3(b). Emisi GRK di lahan sawah irigasi pada beberapa pola rotasi tanaman selama 2 musim tanam. Penelitian ini menggunakan rancangan *oversite design* dengan satu faktor yaitu pola rotasi tanaman. Terdapat 4 pola rotasi tanaman di lahan sawah irigasi yaitu 1) padi-padi-jagung, 2) padi-padi-kedelai, dan 3) padi-padi-padi yang masing-masing dikelola secara anorganik, serta 4) padi-padi-padi yang dikelola secara organik. Penelitian tahap I menggunakan metode survei dan pembuatan profil tanah pada setiap lokasi penelitian. Parameter yang diamati mengikuti borang karakteristik dan morfologi profil tanah. Tahap II dilakukan selama 2 musim tanam (MT), yaitu MT I dan MT II tahun tanam 2018. Tahap 2a. dengan menanam padi varietas Inpari 23 saat MT I dan Mentik Wangi saat MT II. Teknik budidaya padi sawah yang diterapkan mengikuti kebiasaan teknik budidaya padi sawah yang dilakukan oleh petani setempat. Tahap 2b. dengan menggunakan teknik *litter bag* dari seresah yang dominan di setiap petak penelitian. Setiap petak terdapat 7 *litter bag*, untuk pengamatan setiap 2 minggu sekali selama pertumbuhan tanaman padi. Tahap 3a. melakukan pengambilan sampel gas CO_2, CH_4 dan N_2O secara bersamaan dalam setiap kali pengambilan sampel gas GRK. Sampel gas diambil sebanyak 5 kali per musim tanam, dengan mengikuti fase pertumbuhan tanaman yaitu setelah pindah tanam, vegetatif, generatif, pengisian bulir dan panen. Hasil penelitian menunjukkan bahwa : 1) Morfologi tanah sawah memiliki warna 10 YR 3/2 , 4/1 , 4/2. Ditemukan horizon bahan induk di lahan yang menerapkan rotasi tanaman padi-padi-padi baik yang dikelola secara organik maupun anorganik pada kedalaman > 100 cm di bawah permukaan tanah. Lapisan tapak baja (Bwg) didapati pada horizon Bw1 di lahan yang menerapkan pola rotasi tanaman padi-padi-kedelai, dan padi-padi-padi yang dikelola secara anorganik, dan di horizon Bw2 di lahan yang menerapkan pola rotasi tanaman padi-padi-jagung, dan padi-padi-padi yang dikelola secara organik. Karakteristik tanah sawah irigasi pada lokasi penelitian memiliki pH agak masam. Lahan padi-padi-jagung dan padi-padi-kedelai bertekstur geluhan, dan geluh lempungan di lahan yang menerapkan pola rotasi tanaman padi-padi-padi baik yang dikelola secara organik maupun anorganik. C-organik tertinggi sebesar 2,26% di lahan padi-padi-padi yang dikelola secara organik dengan BV 1,58 g cm^{-3}. Lahan sawah di lokasi penelitian memiliki tingkat kesuburan yang rendah dengan faktor pembatas yang krusial yaitu ketersediaan hara N, P dan K. Jenis tanah dari keempat lahan sawah tersebut masuk dalam satu seri tanah yang sama yaitu *Typic Epiaquepts*, geluhan halus, campuran, isohipertermik, Sriharjo. 2) Produktivitas padi Inpari 23 tertinggi diperoleh di lahan padi-padi-padi yang dikelola secara anorganik dan organik yaitu masing-masing sebesar 8,1 dan 7,1 t GKG ha^{-1}. Sedangkan untuk varietas Mentik Wangi masing-masing sebesar 6,5 dan 6,4 t GKG ha^{-1}. 3) Laju dekomposisi seresah di lahan sawah irigasi pada beberapa pola rotasi tanaman mengikuti persamaan kinetika *First Order* dengan nilai R^2 = 0,925 – 0,997. Laju pelepasan hara C dan N mengikuti persamaan kinetika *non linier* dengan nilai R^2 = 0,8841 – 0,9887. 4) Perbedaan penerapan pola rotasi tanaman di lahan sawah irigasi mempengaruhi distribusi vertikal dan horizontal fraksi C-tanah yaitu C-organik, C-POM dan C-mic. Distribusi vertikal dan horizontal fraksi C-tanah dari kadar terendah sampai tertinggi yaitu C-min < C-ws < AF < C-mic = AH < C-POM < C-organik. Perbedaan penerapan pola rotasi tanaman mempengaruhi distribusi vertikal fraksi N-tanah yaitu N-total dan N-POM, dan mempengaruhi seluruh fraksi N-tanah untuk distribusi secara horizontal. Kadar fraksi $N\text{-}NH_4^+$ dalam distribusi vertikal fraksi N-tanah sawah jauh lebih besar dari pada kadar fraksi $N\text{-}NO_3^-$, sedangkan pada distribusi horizontal kadar fraksi $N\text{-}NO_3^-$ jauh lebih besar dari pada kadar fraksi $N\text{-}NH_4^+$. Distribusi vertikal fraksi N-tanah dari kadar terendah sampai tertinggi yaitu N-POM < N-mic < $N\text{-}NO_3^-$ < $N\text{-}NH_4^+$ < N-total, sedangkan untuk distribusi horizontal yaitu N-POM < N-mic < $N\text{-}NH_4^+$ < $N\text{-}NO_3^-$ < N-total. 5) Budidaya padi di lahan sawah irigasi dapat berfungsi sebagai sumber dan rosot emisi GRK. Besarnya emisi GRK di lahan sawah berhubungan dengan kadar lengas tanah, fase pertumbuhan padi, dan jenis varietas padi. Produktivitas padi yang semakin tinggi cenderung semakin meningkatkan fluks emisi CH_4, dan semakin tinggi postur tanaman padi cenderung semakin meningkatkan emisi gas N_2O. Pola rotasi tanaman padi-padi-padi yang dikelola secara organik menghasilkan emisi CH_4 terendah, dan pola rotasi tanaman padi-padi-padi baik yang dikelola secara organik maupun anorganik menghasilkan emisi N_2O yang lebih rendah dari pada lahan yang menerapkan pola rotasi tanaman padi-padi-jagung dan padi-padi-kedelai.

Kata kunci : fluks, musim tanam, padi, produktivitas, varietas

ABSTRACT

Storage of soil C and N in form of total C and total N are in form of organic and inorganic. C and N fractions are also found in the atmosphere, namely CO_2, CH_4, CO, N_2 and N_2O gases. The main greenhouse gases (GHG) are CO_2, CH_4 and N_2O in which rice cultivation can emit that gases. Paddy fields play an important role in mitigating CH_4 and N_2O gases. This study aims to 1) Determine the characteristics, morphology and soil classification of irrigated paddy fields in several crop rotation patterns, 2) Determine the growth and productivity of Inpari 23 and Mentik Wangi varieties in several crop rotation patterns, 3) Determine the rate of litter decomposition in irrigated paddy fields during lowland rice cultivation in several crop rotation patterns, 4) Determine the distribution of C and N fractions of paddy soil in several crop rotation patterns, and 5) Obtain the magnitude of GHG emissions resulting from irrigated lowland rice cultivation in several crop rotation patterns. This research was conducted in three stages, Phase I: The characteristics, morphology, and classification of irrigated paddy soil in several crop rotation patterns. Stage II : 2(a). the dynamics of rice growth and productivity during two growing seasons in irrigated paddy fields on several crop rotation patterns, and 2(b). The decomposition rate of litter in irrigated paddy fields during lowland rice cultivation in several crop rotation patterns. Stage III : 3(a). The vertical and horizontal distribution of C and N fractions of irrigated paddy soil in several crop rotation patterns, and 3(b). GHG emissions in irrigated rice fields in several crop rotation patterns for 2 planting seasons. This study used an Oversite Design with one factor which is crop rotation patterns. There are 4 crop rotation patterns in irrigated rice fields, namely 1) rice-rice-corn, 2) rice-rice-soybeans, and 3) inorganic rice-rice-rice, and 4) organic rice-rice-rice. The Phase I research used survey methods and soil profiling at each research location. Parameters observed followed the characteristics and morphology form of the soil profile. Phase II was carried out for 2 planting seasons (PS), namely PS I and PS II in planting year of 2018. Stage 2a. was done by planting Inpari 23 varieties during PS I and Mentik Wangi during PS II. The rice cultivation technique applied where following the local farmer. Stage 2b. by using the litter bag technique from the dominant litter in each study plot. Each plot contained 7 litter bags for every 2 weeks observation during the rice plants growth. Stage 3a. take samples of gases CO_2, CH_4 and N_2O simultaneously in every GHG gas sampling. Gas samples were taken 5 times per planting season, following the phases of plant growth, which are after transplanting, vegetative, generative, grain filling and harvesting. The results showed that: 1) The morphology of the paddy soil has a color of 10 YR 3/2 , 4/1 , 4/2. The parent material horizon was found on field that applied rice-rice-rice crop rotation, both organically and inorganically managed at a depth of > 100 cm below the soil surface. The plow pan layer (Bwg) was found in the Bw1 horizon on field that applied the rice-rice-soybean and inorganic rice-rice-rice crop rotation pattern, and in the Bw2 horizon on the field that applied the rice-rice-corn and organic rice-rice-rice crop rotation pattern. The characteristics of irrigated paddy soil at the research site has a slightly acidic pH. The rice-rice-corn and rice-rice-soybean fields have textured loam, and clay loamy on field that applies a rice-rice-rice crop rotation pattern, both managed organically and inorganically. The highest organic C was 2.26% in organic rice-rice-rice field with a BV of 1.58 g cm^{-3}. The rice fields in study area have a low fertility rate with a crucial limiting factor were availability of nutrients N, P and K. The four paddy fields soil types were included in one soil series of *Typic Epiaquepts*, fine loam, mixed, isohyperthermic, Sriharjo. 2) The highest productivity of Inpari 23 was obtained for both inorganic and organic rice-rice-rice fields, which were 8.1 and 7.1 t GKG ha^{-1}, respectively. Meanwhile, the Mentik Wangi varieties were 6.5 and 6.4 t GKG ha^{-1}, respectively. 3) The rate of litter decomposition in irrigated rice fields in several crop rotation patterns followed the *First Order* kinetic equation with R^2 value of 0.925 – 0.997. The release rate of C and N nutrients followed the *Non-Linear* kinetic equation with R2 value of 0.8841 – 0.9887. 4) The differences in the application of crop rotation patterns in irrigated paddy fields affect the vertical and horizontal distribution of the C-soil fraction which are organic C, C-POM and C-mic. The vertical and horizontal distribution of soil C fraction from lowest to highest content were C-min < C-ws < FA < C-mic = HA < C-POM < organic C. The difference in the application of crop rotation patterns affects the vertical distribution of the soil N fraction which were total N and N-POM, and affects the entire soil N fraction for horizontal distribution. The levels of the N-NH_4^+ fraction in the vertical distribution of the soil N fraction were much greater than the levels of the N-NO_3^- fraction, while in the horizontal distribution the levels of the N-NO_3^- fraction were much greater than the levels of the N-NH_4^+ fraction. The vertical distribution of the soil Nsoil fraction from the lowest to the highest was N-POM < N-mic < N-NO_3^- < N-NH_4^+ < total N, while the horizontal distribution was N-POM < N-mic < N-NH_4^+ < N-NO_3^- < total N. 5) Rice cultivation in irrigated paddy fields serve as sources and sinks of GHG emissions. The amount of GHG emissions in paddy fields was related to soil moisture content, rice growth phase, and types of rice varieties. Higher rice productivity tends to increase CH_4 emission fluxes, and the higher rice plant posture tends to increase N_2O gas emissions. The organic rice-rice-rice crop rotation pattern produced the lowest CH_4 emissions, and the both crop rotation pattern of inorganic and organic rice-rice-rice produced lower N_2O emissions than fields that applies the rice-rice-corn and rice-rice-soybean crop rotation pattern.

Keywords: flux, planting season, rice, productivity, varieties