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Soil wettibility during straw incubation as affected by numbers and intensities of wetting and drying

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Rice straw is usually fired in the field after harvesting in China which causes environmental problems. On another hand, upland soils are becoming degraded as low organic matter input. Incorporation of rice straw into upland soil may improve soil structure against soil degradation. Wetting and drying cycles accumulate dissolved organic carbon (DOC) in surface soils and decreases soil wettibility. The decreases of soil wettibility may stabilize soil structure due to less air stress exerted within soil during wetting. The accumulated DOC may result from soil organic carbon or from the dead microbes after drying. In the late case, soil wettibility may also be affected by intensity of dryness in relation to the changes of microbial processes. The aim of this research is to determine if microbiological and physical processes moderate soil wettibility during straw incorporation and the influences of wetting and drying cycles and intensities on soil wettibility. Ground soil and rice straw ($<$2 mm) was compacted into 100 cm^3 cylinders at a bulk density of 1.2 g cm^{-3}. The soil cores were subjected different wetting and drying intensity and cycles within 3 months. Changes in soil volume, soil water repellency, DOC concentration, CO_2 emission, microbiomass-C and N were measured simultaneously at different times during the incubation period. The soil volume decreases by 3-6% with incubation time. The greatest decreases were for the greatest drying intensity treatment (8-d). Soil pore size distribution changed as well during the incubation period. The CO_2emission during the incubation decreased with time and can be described by the first order exponential decay function.

$$y = y_0 + a_1 e^{-x/t1}$$

According to the function, the drying intensity treatment did not affect the basal mineralization rate (y_0), which was about 4.3-4.6 μg kg^{-1} soil. The decay constant (t1) was similar between the 3-d (21.55 +/-2.8μg kg^{-1} soil) and 5-d treatments (22.31+/-

3.0 μg kg^{-1} soil), which was significantly higher than the 8-d treatment (15.96+/-1.2 μg kg^{-1} soil).

Assuming the CO_2 during the drying process is negligible, the accumulated CO_2-C during the 120 days incubation were not significantly different, ranging from 73.3 mg for 3-d treatment, 76.3 mg for 5-d treatment, and 80.8 mg for 8-d treatment. Soil microbial biomass-C content was greater in the greater drying intensity treatment (8-d >5-d>3-d). Soil microbial biomass-N content showed an exponential decay with incubation time in the 5-d and 8-d treatments. It showed slight increases at 3 and 6 w/d cycles in the 3-d treatment. The microbial biomass C and N ratio also peaked at about 40 days incubation. The peaked C:N ratio ranged from 10 to 17, tending decreased within lower drying intensity. The stable C:N ratio was about 5. The C:N ratio indicates that the soil microbial community changed during the incubation, the higher C:N values for more dominant fungi. The dynamics of soil microbes did not correspond to the CO_2 emission dynamics, especially the flushes. However the change in saturated soil water content was closely correlated to the CO_2 emission dynamics. The soil water repellency was greatest on the soil core surface exposed to air and decreased with increased soil depth in the soil cores. The soil water repellency profoundly increased after the 1 w/d treatment on the surface soils. It corresponded to the dynamics of soil microbial biomass during the incubation, rather than to the dynamics of DOC although DOC was enriched on the surface soil during the repeated wetting and drying cycles. In addition, soil water repellency was related to soil water content, which was lower in the surface soil. These results suggest that The interaction of the biological and physical processes not only alter the CO_2 emission, but also changed soil water repellency. Water repellency corresponded to microbial biomass-C, rather than DOC movement, and soil structure change. Modeling of soil organic matter decomposition should consider soil physical condition which is strongly affected by intensity of drying.