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The effect of the size of clods on water movement through plowed soil in clayey rotational paddy field

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Because poor tilth of clayey rotational paddy field frequently causes unstable emergence of soybean, prediction of water distribution in the plowed soil with huge clods draws farmer's concern. Upward water movement through the plowed soil layer with some centimeters clods is characterized by the extremely limited contact area between clods and the large inter-clods pore space. While the liquid water flow is highly regulated by the limited contact points, vapor flow is less controlled by the pore structure. This study aimed to clarify the effect of the tilth on vertical water distribution and evaporation rate during the dehydration process in clayey rotational paddy fields. The surveys were conducted for a few weeks with clear weather after the seeding of soybean in 2016 and 2017, although 5.5 mm rain fell during survey period in 2017. In 2016, two rotational clayey paddy fields with different tillage treatments were subject to the experiment. One was 'poor tilth' plot where flooded rice was planted in the previous year. The other was 'good tilth' plot where soybean had been planted for five years. The weight of the clods less than 2 cm after treatments was 8.9% and 76.5% in the poor tilth and good tilth plot, respectively. In 2017, three rotational clayey paddy fields such as poor tilth, good tilth and 'compacted' plot where the most of clods were crushed by the compaction roller were subject to the experiment. The weight of the clods less than 2 cm was 35.9%, 69.7% and 89.5% in the poor tilth, good tilth and compacted plot, respectively. The soil of these plots was smectitic gray lowland soil. Gravimetric water content up to 10 cm depth at 2 cm intervals was measured. Evaporation rate was also measured in 2017. In 2016, the poor tilth plot showed less averaged water content through upper 10 cm layer than the good tilth plot. The inflection point of the vertical water content distribution was formed at 5 cm in the poor tilth plot, suggesting the deepening of the layer of active evaporation due to the considerable desiccation near the ground surface. In 2017, the water content averaged through 8 cm in the poor tilth plot was less than the good tilth plot at the end of the surveying period, while no difference was revealed in the evaporation rate. The water balance during the monitored period showed the upward water supply from the deeper layer (<3 cm) in the poor tilth plot was smaller than the others. Because the final vertical water content distribution did not have an inflection point at the stage, the retained water near the ground surface was sufficient for the evaporation demand and the upward water supply from the deeper layer did not affect the evaporation rate. These results suggest the worse tilth can cause rapid desiccation of plowed soil, while the agronomical importance depends on the weather after seeding. For further quantitative discussion, the phenomenological studies of the upward water movement through or between the huge clods are highly required.