Influence of Japanese red pine and evergreen oak trees on soil water balance

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The forest not only produces wood and the carbohydrate but also has a lot of functions and the effects for our life. The forest prevents a rapid outflow of water to the river by infiltrating the rainfall and has the function of preventing the flood. Moreover, the forest plays an important role for the hydrological cycle near the surface. Therefore, it is important to evaluate the influence of the forest on the soil water balance.

Japanese red pine (Pinus densiflora Sieb. Et Zucc.) is the most widely planted tree species in Japan. Because Japanese red pine is an intolerant tree, the vegetation succession progresses if sun light doesn't enter into the forest floor by the lower vegetation. Moreover, today, the forest management comes to abandon, the vegetation succession progresses from Japanese red pine to evergreen broad-leaved trees (Quercus myrsinaefolia Blume). In addition, it is thought that the vegetation succession will progress by the climate change in a future. Furthermore, the amount of transpiration and the volume of stem flow will change due to the change of the forest structure by the vegetation transition. It is supposed that these phenomena will affect the soil water balance by the change of hydrological cycle of the forest.

Iida et al. (2005) reported that it is important to make clarify the influence of the stem flow and the interception on the soil water balance of the forest where the vegetation succession progresses from Japanese red pine to evergreen oak. Because the Japanese red pine has a structure to hold the water easily, and the amount of interception is large and the stem flow is a little. On the other hand, the evergreen oak cannot hold the water so much, and the amount of interception is a little and the stem flow is large.

Kakubari (2005) suggested that the vegetation species difference affects the groundwater recharge process by observing the heterogeneity of soil water content underneath the Japanese red pine and the evergreen oak. This paper also reported that the main reason is a difference of the stem flow volume and the rhizome structure due to the difference of vegetation species. Moreover, there is a strong sink zone underneath the Japanese red pine at the depth of 70 cm and the pressure head indicates a low value even after a heavy rainfall. On the other hand, groundwater recharge occurs immediately after rainfall underneath the evergreen oak. These facts indicate that the soil water balance is different depending on a different vegetation species.

The present study was undertaken in order to establish the method of continuously quantifying the soil water content for clarifying the soil water balance of the forest and quantify the influence of the Japanese red pine and the evergreen oak trees on the soil water balance.

For calculating the soil water balance, it is possible to divide into three types of condition such as wet period, dry period and after the rainfall. There is a strong water up take zone underneath the Japanese red pine from the depth of 20 cm to 100 cm. In a dry condition, strong water up take zone is moved downward. Daily transpiration was estimated as substantially constant value from 1.23 to 2.95 mm. On the other hand, there is a strong water up take zone underneath the evergreen oak from the depth of 20 cm to 70 cm and from the depth of 100 cm to 150 cm, respectively. However, in a dry condition, strong water up take zone is restricted only from the depth of 20 cm to 70 cm. On the other hand, after rainfall, the amount of water up take from groundwater is large because a lot of stem flow occurs from the evergreen oak and the water table rise up at the rainfall. Daily transpiration was estimated from 1.19 to 4.85 mm. Therefore, the amount of transpiration of the evergreen oak is greatly changed according to the climatic condition at the study site.