

Development of Dose Assessment Method for a Conifer

Yoshihito OHTSUKA, Masanori FUJII, Yoshiko AYABE, Shinji UEDA,
Yuichi TAKAKU, Shun'ichi HISAMATSU
Department of Radioecology

Abstract

Protection of an ecosystem itself from radiation has become an important theme in the research field of radiation safety. Since conifers are known to be more sensitive than other organisms in the general environment, we planned to establish the radiation dose assessment method for one type of conifer and get its natural background radiation dose rate. After considering that the first commercial spent nuclear fuel reprocessing plant is now under construction in Rokkasho, Japan, we selected a forest of Japanese black pine (*Pinus thunbergii*), about 4 km away from the main stack of the plant, as our target field. In addition, we studied the iodine dynamics in the forest for possible radioiodine release from the plant.

A black pine tree in midrange size in the target field was sampled in July 2017. The whole tree body including below-ground part was collected and classified into trunk, branches, leaves, pinecones, stump and tap roots and horizontal roots. Their dimensions, weights, water contents, and stable element concentrations were measured for deciding shape and elemental composition of the tree phantom for radiation dose evaluation. Their radionuclide concentrations were also determined for evaluating natural background radiation dose rate. Wet weights of the above- and below-ground parts were found to be 468 kg and 94 kg, respectively. We plan to get similar data for two more trees in the coming two fiscal years, and finally get a representative data set for a phantom of the pine tree and its radionuclide concentration. Litter and soil samples collected in 0 – 2 m depths around the sample tree were analyzed for apparent density and stable element concentrations for radiation dose evaluation.

For getting background external dose rate, the vertical distribution of environmental γ -ray dose rates in the forest was measured with electronic dosimeters and it was found that the radiation dose rates at 1.5 – 15 m above the ground were similar to each other with only a slight decrease at higher positions.

To study iodine dynamics in the forest, we measured iodine concentrations in plant, atmospheric and hydrological samples. Mean inventory of stable iodine in the pine tree was evaluated to be $2.9\text{E-}2$ g individual⁻¹. The dry deposition rates of particulate and gaseous iodine were evaluated to be 3.6 m d⁻¹ and 89 m d⁻¹, respectively, from the difference of dry deposition fluxes and particulate and gaseous concentrations in air inside and outside the forest during the non-precipitation period. The mean removal rate of iodine from the forest was estimated to be $2.3\text{E-}6$ g m⁻² mm⁻¹ precipitation based on the difference of wet iodine depositions inside and outside the forest.

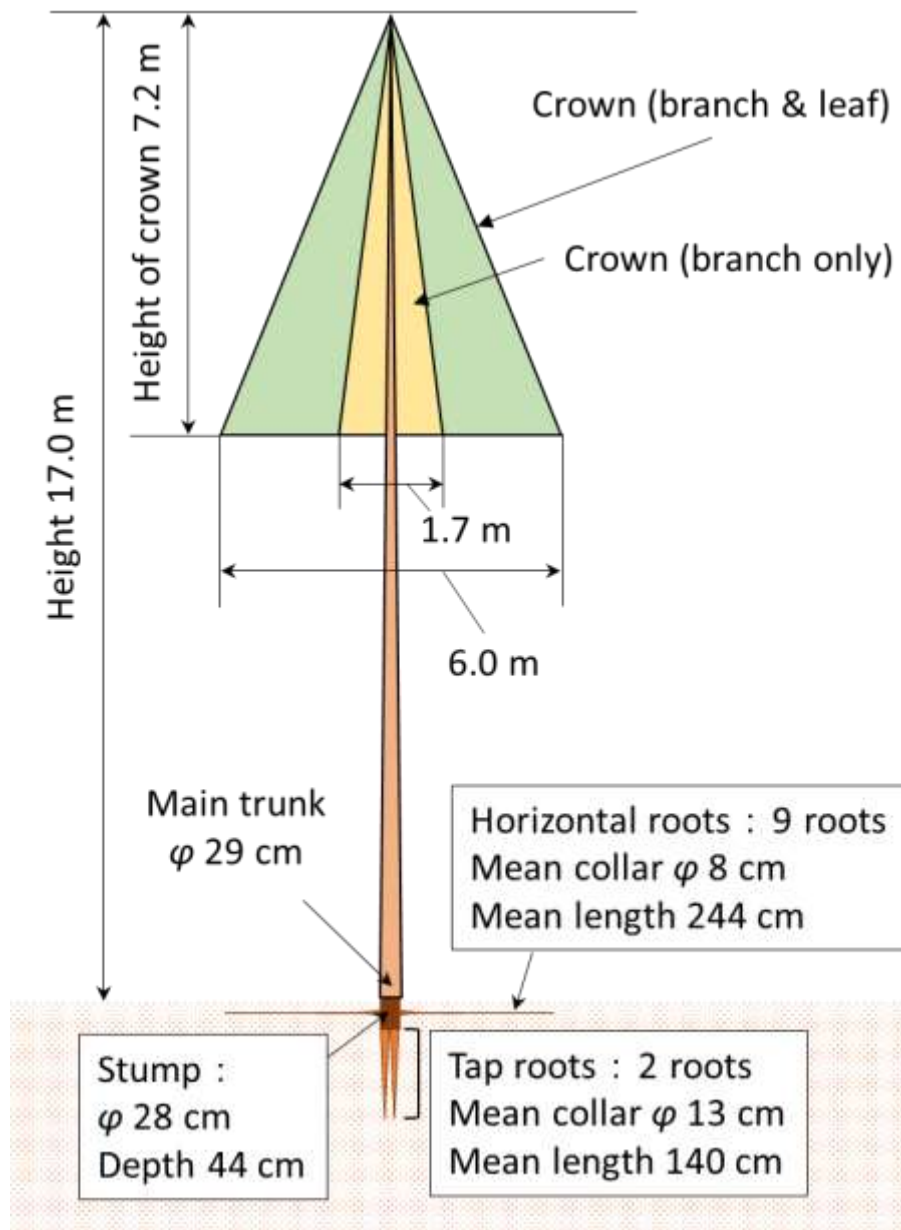


Fig. 1 The external form of Japanese black pine constructed based on the present sample tree and above-ground part of four other trees collected so far in a Rokkasho forest.