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Radiation effects in Fukushima: morphological abnormalities in Japanese red pine (Pinus densiflora)

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Our research, carried out in 2014-2017, showed the high radiosensitivity of the young trees of Japanese red pine (Pinus densiflora). We found the increased rates of cancellation of the apical dominance in the young populations of this species growing at several locations at the radioactive contaminated territories in Fukushima prefecture. However, we did not observe any morphological abnormalities in the mature trees of Japanese red pine growing at the study locations.

Each studied population of Japanese red pine consisted of the trees of different ages (germinated in 2011 or later). In this reason, taking into account the significant reduction of the dose rates with time after the Fukushima accident, the probabilities of cancelling the apical dominance correlated with the dose rates the trees received in the first year of their development rather than with the average dose rates measured at the experimental sites. The probabilities increased from 0.11 and 0.14 in the two less irradiated populations to as high as 0.9 at in the group of the trees that received 25 mGy/h in the first year of exposure. In all groups of the trees, independently on the dose rates, the abnormalities formed in the second to fourth whorls after the beginning of exposure with the maximum output in the second whorl.

The abnormalities observed in our study in Japanese red pine are similar to those observed earlier in the young trees of the closely related species, Scots pine (Pinus sylvestris), in the Chernobyl zone, as well as similar are the temporal patterns of their formation. Moreover, similar morphological changes were reported for other conifer species in Fukushima. The further in-depth studies of the response to radiation occurring at the various levels of organism are necessary for clarification of the mechanism of this radiation effect.