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Quantification of Carbon Uptake in Urban Roadside Ecosystem by Measuring Carbon Exchange from the Leaf, Stem, and Root of the Shrub

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One of the ways to increase green areas that are shrinking due to urbanization is to create urban roadside greenery. Among the various ecosystem services of roadside greenery, carbon uptake plays a significant role in reducing CO_2, the main factor of climate change. Multi-layered planting can enhance carbon uptake, which is focused on as an effective method. Hence, the roadside ecosystem consists of trees, understory shrubs, and soil. Although shrubs are as crucial as trees because of the large number of populations per unit area, only a few studies were focused on shrubs. Therefore, considering shrub carbon uptake is necessary for estimating the accurate carbon exchange on the roadside ecosystem.

This study focused on the roadside greenery composed of a tree, shrubs, and soil in the unit 1m x 8m area. The experiment was conducted in Suwon city, the Republic of Korea. The selected tree and shrub are *Zelkova serrata* and *Euonymus japonicus*, the most common species in Suwon. Net Ecosystem Exchange(NEE) was calculated by the equation [$NEE = NPP_{tree} + NPP_{shrub} + R_{heterotroph}$]. NPP_{tree} was estimated through the allometric equation. NPP_{shrub} and $R_{heterotroph}$ were calculated through measurements. To calculate NPP_{shrub}, two experiments were conducted. One was field measurement using the closed chamber with LI-820, and another was greenhouse incubation and harvesting. In the field measurement, the closed chamber measured the real-time change of CO_2 concentration including leaf photosynthesis and stem respiration, and the results showed the aboveground NPP_{shrub}. Also, environmental factors such as air temperature, PAR (photosynthetically active radiation), and leaf area were collected. In the greenhouse experiment, the results showed the accurate NPP_{shrub} without considering field conditions. With those two results, the equation for calculating field shrub NPP was developed considering field conditions and root respiration. However, the closed chamber has a problem with installation, management, and stability, so the leaf chamber would be more adaptable for field measurement than the closed chamber. For accurate measurement of field shrub NPP, this study also did an experiment using Vaseline to block the stomata to calculate the proportion of stem respiration in the aboveground NPP_{shrub}. The stem respiration can be measured by comparing the CO_2 concentration change before and after pasting Vaseline on the shrub leaves in the closed chamber. Soil respiration(R_s) was measured by EGM-5 in the field and used the equation [$R_s = R_{root} + R_{heterotroph}$].

The results of these experiments accurately estimated NPP_{shrub} and $R_{heterotroph}$, and the NEE of the

1m x 8m roadside greenery section could be quantified as 5.23 kg C/yr. This amount could mitigate 1.09% of annual vehicle carbon emissions in Suwon city if roadside greenery is applied on all roadsides in Suwon.