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Smart Tree pillar: Efficiency of tropical plants on the reduction of fine particulate matters ($PM_{2.5}$) in urban areas

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Implementing green infrastructure, specifically utilising plants to absorb air pollutants, offers a promising solution for reducing air pollution in urban environments. The Smart Tree pillar, designed to mitigate $PM_{2.5}$ by using filters and plants, aims to achieve two main objectives: 1) design, create, and develop the tree pillar to mitigate $PM_{2.5}$ by capturing $PM_{2.5}$ dust while still being suitable for urban climates; 2) investigate the capture and physiological responses of three plant groups (C3, C4, and CAM). Testing individual plant efficiency on $PM_{2.5}$ reduction among 10 species in a closed chamber showed that *Celosia argentea* L., *Cordyline fruticosa* (L.) A.Chev., and *Pennisetum setaceum* (Forssk.) Chiov. 'Purpureum' are more effective than others. The study of dust trapping in the surface layer and wax layer found statistically significant differences. The top four species for capturing $PM_{2.5}$ particles (0.2–2.5 microns) in the surface layer and wax layer are *Celosia argentea* L., *Ficus elastica* Roxb. ex Hornem., *Ehretia microphylla* Lam., and *Neoregelia* 'Exotica Velvet'. The Smart Tree pillar to mitigate $PM_{2.5}$ consists of the following components: a pre-filter and an air filter. It is equipped with a steel grating for plant installation at a size of 300 cm (width) by 350 cm (height). Additionally, the Smart Tree pillar is outfitted with Internet of Things (IoT) technology, enabling remote control of the system and data recording of $PM_{2.5}$ dust concentration, humidity, and temperature, as well as initiating automatic watering as required. Monitoring of the tree pillar purifier innovation outdoors at Central Plaza Chiangmai Airport during April 2022–July 2022 revealed a significant reduction in $PM_{2.5}$ levels from above 100 µg/m³ to approximately 8–18 µg/m³, equating to 84–94 percent reduction. In this study, the number of days with $PM_{2.5}$ levels above the standard (50 µg/m³) was reduced in urban installations.