National Institute of Environmental Health Sciences

Spectral properties of plant leaves pertaining to urban landscape design of broad-spectrum solar ultraviolet radiation reduction

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Abstract:

Human exposure to harmful ultraviolet (UV) radiation has important public health implications. Actual human exposure to solar UV radiation depends on ambient UV irradiance, and the latter is influenced by ground reflection. In urban areas with higher reflectivity, UV exposure occurs routinely. To discover the solar UV radiation regulation mechanism of vegetation, the spectral reflectance and transmittance of plant leaves were measured with a spectrophotometer. Typically, higher plants have low leaf reflectance (around 5%) and essentially zero transmittance throughout the UV region regardless of plant species and seasonal change. Accordingly, incident UV radiation decreases to 5% by being reflected and is reduced to zero by passing through a leaf. Therefore, stratified structures of vegetation are working as another terminator of UV rays, protecting whole terrestrial ecosystems, while vegetation at waterfronts contributes to protect aquatic ecosystems. It is possible to protect the human population from harmful UV radiation by urban landscape design of tree shade and the botanical environment. Even thin but uniformly distributed canopy is effective in attenuating UV radiation. To intercept diffuse radiation, UV screening by vertical structures such as hedges should be considered. Reflectivity of vegetation is around 2%, as foliage surfaces reduce incident UV radiation via reflection, while also eliminating it by transmittance. Accordingly, vegetation reduces incident UV radiation to around 2% by reflection. Vegetation influence on ambient UV radiation is broad-spectrum throughout the UV region. Only trees provide cool UV protective shade. Urban landscapes aimed at abating urban heat islands integrated with a reduction of human UV over-exposure would contribute to mitigation of climate change.

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Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Solar Radiation

Geographic Feature:

resource focuses on specific type of geography

Urban

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Asia

Asian Region/Country: Other Asian Country

Other Asian Country: Japan

Health Impact: ☑

specification of health effect or disease related to climate change exposure

General Health Impact

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation, Mitigation

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Time Scale Unspecified