Flow resistance adaptation of aquatic macrophytes under different flow velocities

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Abstract

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Many studies have demonstrated that plants have the ability to affect flow velocity, and plant materials have been investigated for their potential to be used as a buffer zone to prevent riverbank erosion. However, relatively
few studies have investigated the effects of plant characteristics on flow conditions. In this study, an artificial channel was constructed to (1) investigate the nature of the morphological changes undergone by aquatic Oenanthe javanica DC (water celery) macrophytes in response to different channel flow velocities and (2) identify the tolerance limit of aquatic macrophytes under different flow velocity conditions. Results show that the morphology of Oenanthe javanica DC exhibits the following variations under different flow velocities: as flow velocities increase, growth rate slows and plant shoots become shorter and softer, thereby increasing plant flexibility. These variations were accompanied by a decrease in root length and root anchorage capacity. In response to different flow velocities, a nonlinear relationship in growth rate between total new green leaves and yellow leaves was also observed. The number of vascular bundles in new shoots was found to decrease in a flowing water environment, compared with the number of vascular bundles in terrestrial environments. The average density of vascular bundles, however, was found to increase as flow velocity increased, most likely to provide a compensatory structural support mechanism. The results of this research identified a suitable range of flow velocity for water celery as 0.05–0.30m s 1, which is approximately equal to the average flow velocity of dredged rivers in Taiwan. Because of its abundant growth in Taiwan and its ability to adapt to the range of velocity conditions found in

Taiwan’s dredged rivers, water celery was found to be an appropriate planting material for intertidal zones and reservoir bank protection.

Keyword：flow resistance adaptation; flow velocity; aquatic macrophyte; artificial channel; ecological engineering