Development of Roof Vegetation as Influenced by Substrate Composition and Depth in an Extensive Green Roof

D.H.B.R. Dassanayake and C.K. Beneragama

Department of Crop Science, Faculty of Agriculture, University of Peradeniya

Green roofs involve growing plants on rooftops, partially or completely covered with vegetation grown on a growth substrate, laid over a waterproofing membrane. Extensive green roofs are shallow, with less than 15 cm of substrate. The interest for green roofs are increasing because of the enormous benefits that these roofs render, such as decreasing the urban heat island effect, storm water runoff mitigation, saving on energy consumption, increasing the life span of a typical roof, ability to filter harmful air and water pollutants, sound insulation, fire resistance and especially because these green roofs provide aesthetically pleasing open spaces in ultra urban areas. Although green roofing is a good solution to address the issues created by urbanisation in Sri Lanka, few scientific studies have been carried out on green-roofs. Thus, the present study was carried out to determine an appropriate growth substrate and optimum thickness for extensive green roofs in Sri Lanka since composition of the growth substrate and depth play a pivotal role in development of roof vegetation in any green roof system.

The experiment was conducted throughout 12 weeks at Dodangolla Experimental Station (IM_{3b}), Kandy. Sample plots were arranged in plastic trays (30 × 40 cm), on a conventional asbestos roof with a 25° slope. Three different depths 4 cm (D_1), 7 cm (D_2), 10 cm (D_3) and five different substrate compositions, i.e. compost, sand, coir dust, half-burnt paddy husk and polystyrene beads mixed in various ratios (M_1 to M_5) were evaluated. *Alternanthera sessilis*, one of the potential plants species for extensive green roofs in Sri Lanka, was grown to evaluate the suitability of substrate mix. The amount of plant cover was measured using a grid (frequency-cover) at two weeks intervals. Chemical and physical properties of the substrate mixes were measured at the beginning and at the end of the experimental period. Data were analysed using ANOVA procedure.

Establishment was successful on most trays, but there were significant differences ($P<0.05$) in the frequency-cover among the different substrates. Among the three different substrate depths used, D_3 (10 cm) was best suited for local conditions, irrespective of the composition of the substrate used. By the end of the experimental period, the highest vegetation cover, the lowest depletion of N, P and K nutrients and the lowest change in pH ($P<0.01$) were recorded in the media filled up to 10 cm depth (D_3).

Among the five different substrate compositions, from the beginning of the experiment, M_2 (compost, sand, coir dust and polystyrene beads in 25, 25, 25, and 25% respectively) and M_3 (compost, sand, coir dust, half-burnt paddy husk and polystyrene beads in 25, 25, 25, 12.5 and 12.5% respectively) showed a better and quick roof cover compared to others. Nutrient depletion (N, P and K) was also lower in these two mixtures. Total vegetation cover of the plot area was achieved by the 9th week in M_3D_3. When water-saturated weight was also taken into consideration, the ideal substrate among the 15 different treatment combinations used in this investigation for extensive green roofs in Sri Lanka was M_2 D_3.