Effects of Extensive Green Roof System on Rainwater Circulation*

Lee, Bum-heui\(^1\) · Jang, Ha-kyung\(^2\) and Ahn Geun-young\(^2\)

\(^1\) Division of Environmental Life Sciences, Seoul Women’s University,\n\(^2\) Lab. Ecological Landscape Planning, Seoul Women’s University.

관리조방형 옥상녹화시스템이 우수순환체계에 미치는 영향*

이은희\(^1\) · 장하경\(^2\) · 인근영\(^2\)

\(^1\) 서울여자대학교 환경생명과학부 · \(^2\) 서울여자대학교 조경연구실

국문요약

본 연구는 관리조반형 옥상녹화 시스템의 우수유출 저감 및 유출저감 효과를 규명하기 위하여 2007년~2010년의 4년간 연구를 진행하였다. 실험대상지는 서울여자대학교 행정관 옥상에 조성된 관리조반형 옥상녹화지로 2007년에 조성하였으며, 세 덩류 및 다년생 초화류를 포함하여 총 18종의 식물을 식재하였다. 우수유출 저감 및 지연효과를 지속적으로 모니터링하기 위해 옥상녹화지를 통과한 우수를 저장할 수 있는 시스템을 설치하여 유출수의 유입량 및 시간을 측정하였다. 조사기간 중 총 24번의 강우사례를 분석한 결과 단위면적당 평균 약 90.3%(78.8~99.3%)의 유출량이 저감되었으며, 지연시간은 평균 약 1.6시간으로 나타났다. 본 연구결과를 종합분석해본 바, 빗물이 거의 전량 유출되는 도심의 건축물 옥상을 녹화함으로써 옥상에 유입되는 우수의 유출을 저감 및 지연시키려 도심의 수순환체계 개선에 기여할 수 있을 것으로 생각된다.

주요어: 강우, 유출량, 저감, 지연효과, 도심 수순환체계

* This work was supported by a special research grant from Seoul Women’s University (2011).

First author Lee, Bum-heui, Division of Environmental Life Sciences, Seoul Women’s University,
Tel: +82-2-970-7717, E-mail chlee@swu.ac.kr

Corresponding author Lee, Bum-heui, Division of Environmental Life Sciences, Seoul Women’s University,
Tel: +82-2-970-7717, E-mail chlee@swu.ac.kr

I. INTRODUCTION

The rainwater circulation in urban areas is modified from the rainwater circulation in nature. The hydrological cycle in urban areas is influenced by the change of land uses; for example, from forest to agricultural land, the draining of wetlands and the increase of developed areas. The surface of built up areas is almost covered with paving. Therefore, the surface retention and interception of rainwater are reduced because the surface of the urban area is smooth. The characteristics of the hydrological cycle in urban areas are increased runoff, reduced evaporation and infiltration (Konig K. W, 1996; Lee, E. H, 1997). This causes many unseen problems. The increased runoff causes higher peaks of stream discharge and shortens lag time (Herrmann R, 1977; Dunnett N and Kingsbury N, 2005). In order to prevent disasters, it is necessary to build higher riverbanks and regulation dams and straighten rivers. However, the results of those efforts are often higher water levels, the disturbance of aquatic ecosystems and reduction of biodiversity. It is difficult in urban areas to increase green areas, but the roofs, where the runoff coefficient is almost one, have a great potential to be green space because the areas of roofs in urban areas are immense and the spreading effects are also enormous. For example, Seoul today is beset with perplexing difficulties where 48% of urban areas are over 70% paved zones (Seoul metropolitan government, 2001). The rainfall runoffs of parks, natural ground and green roofs are low, while those of slope roofs and paving areas with asphalt are very high.

Urbanization also increases surface runoff by creating more impervious surfaces such as paved-
ment and building that does not allow percolation of the water down through the soil to the aquifer. It is instead forced directly into streams or storm water runoff drains where erosion can be a major problem, even when flooding is not. Increased runoff reduces groundwater recharge, thus lowering the water table and making droughts worse (Kim YR, 2008).

In the case of Seoul, heavy floods cause a great deal of damage to the area annually. In the flood occurrence period, surface runoff volume increased about 2,488,000 m³ per day (www.ecoinfo.seoul.go.kr). Incidence of sudden severe rain storm has become more frequent over the last few years.

There is some studies on Reducing, attenuating and mitigating storm water runoff which lowers risks of urban floods and improving the urban water balance to approach the natural one (Bengtsson et al., 2005; Berndtsson J C, 2010; Krupka B, 1992; Mentena et al., 2006; Roth-Kleyer S, 2005; Schmidt M, 2005; VanWoert et al., 2005). But few studies have been conducted to analyze annual monitoring result for effect of green roof on runoff retention quantity and time-lag in Korea where has climate heavy rain are concentrated in summer.

Therefore the objective of this study was to analyze how extensive green roof systems function in the local weather conditions, as the result of observing an existing green roof in Seoul, Korea. The task was to assess the storm water retention potential as well as the runoff water quantity and lag time of a green roof. Twenty four different rain events were observed in the measuring period from September 2007 to July 2010.