Green Roofs: The Next Horticultural Revolution©

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Imagine looking, as I did this spring, at 250,000 square feet of German rooftop covered with a variety of sedums. As a propagator, your wallet should be quivering in anticipation. To vegetate that green roof required tons of cuttings. Will that type of opportunity ever come to the U.S.A.? The answer is yes, and probably sooner than you think. However, Americans know little about green roofs and their substantial advantages to the landscape.

Green roofs are, as the name implies, plantings that are placed on the roof of a building. Plant size and selection depends on the depth of the roof overburden (growing medium) and local climate, but the plants are almost always drought tolerant. Low-growing plants such as grasses, sedums, and other cactus-like plants are used where the depth is only a few inches. Where the medium depth is several feet, shrubs and even small trees can be used. Although most easily used on flat roofs, a low pitch roof can also be "greened". Green roofs also represent a significant niche market for horticulturists, especially propagators, who would supply plants for these roofs.

Green-roofs technology is not new. After decades of practice, space-cramped Germans have honed the practice to a fine art. Industry figures suggest that 10% of German roofs are greened. Between 1989 and 1999, German roofing companies installed nearly 350 million ft^2 of green roofs and the rate is increasing. Although information about green roofs is available, installation specifics are mostly proprietary and performance data are largely anecdotal. In either case, there is little actual research information available. Much of the popular semi-technical literature is only written in German, which effectively slows its adoption by Americans. Green roofs have been installed in the U.S.A., in places such as Chicago City Hall, and more are planned, like Ford's River Rouge renovation in Detroit. However, our roof conditions are substantially different than those in Germany. A roof environment in Frankfurt is quite different from one in Atlanta, or Phoenix, or Minneapolis. So, while principles can be applied, Americans need information about our specific conditions.

There are several significant advantages to green roofs:

Storm Water Runoff. Controlling storm water runoff may be the single most important advantage. In most areas of Germany, when a new building is erected, laws may mandate that it have a green roof so runoff is held back and does not overwhelm municipal sewage systems, thus adding to pollution problems. The growing medium, while designed to support plant growth absorbs water and also slows down rain runoff as do the plants themselves.

Aesthetics. The vast grey expanses of industrial flat roofs are visually improved when planted. Is there a monetary return for greening roofs? Probably, especially in urban areas where office building tenants or motel residents can look down on parts of nearby buildings. When "greened", an aesthetically pleasing roof will translate into higher occupancy rates and higher rental rates.

Heat Island Amelioration. This is fast becoming a world wide problem, especially for megacities. It is a known fact that the air above cities is significantly warmer, sometimes up to 15°F warmer than the surrounding countryside. This warming trend is becoming a hot button issue with many environmental ecologists. A landscape architect for Portland, Oregon, recently estimated that roofs occupy nearly 20% of the land area in his city. The same comparison for an older, more crowded eastern city would probably yield a substantially higher percentage. Plants, when they transpire, cool the atmosphere, so they can significantly reduce surrounding temperatures.

Heating and Air Conditioning. These costs can be reduced. The growing medium acts as a natural insulator and can reduce winter heating costs, the greatest savings will be recorded for summer air conditioning. Savings will depend on the thickness, composition and moisture content of the growing medium, plants used, where the roof is located, as well as roof construction factors. Germans depend less on air conditioning than we do in the U.S.A.. Therefore, the impact would be greater in Atlanta than in Frankfurt. Transpiring plants also cool the surrounding atmosphere, often below ambient temperature, and plants scatter light, thus reducing thermal loading.

Green Roofs Lengthen Roof Life. Most roofs are dark colored and absorb heat. The large fluctuations in roof skin temperature can cause expansion and contraction, resulting in leaks and premature failure. In hot climates, roof temperatures may approach 200°F during the day and plunge to 50 or 60°F at night. Because green roofs reduce these dramatic temperature fluctuations, they may, by some estimates, double or triple roof life.

Figure 1. Example of a green roof.

"Grey" Water Renovation. Since all roofs have a natural pitch, rainwater slowly filters through the green roof. One German insurance complex in Nürnberg collects roof runoff from a greened roof and re-circulates the water for toilet use before returning it to the sewage stream. In the future, even grey water may also be recirculated back to the roof for renovation.

The few disadvantages of green roofs can be overcome with careful planning and maintenance. Roof strength would have to be increased to support to planting overburden, which may abrogate its use on some existing roofs. However, it is a simple engineering process with most modern roofs to support the added 10 to 15 lb wet weight ft^{-2}. At the present time, most green roofs have been installed in Germany, a country whose climatic differences are much more uniform than those in the U.S.A. While some technology can be transferred, U.S.A. architects, horticulturists, and roofers must develop new paradigms for our conditions.

ISSUES

Growing Media. These must be light weight. Europeans use combinations of materials like broken roof tiles, calcined clays, scoria, shales, and organic matter. Most of these materials are too expensive to import, so domestic sources must be located. The physical characteristics of these media such as aeration, water-holding capacity, and hydraulic conductivity, must also be addressed.

Plants. Plants used on green roofs are usually low-growing and drought-tolerant species such as sedums (*Sedum*), hens-and-chicks (*Sempervivum*), and grasses. However, depending on medium depth, a variety of other plants can be used, even trees. At the present time, nurserymen are not used to producing plants for roof greening. Networks of growers will have to be established. One roof architect recently told me that he is involved in as upcoming job in the U.S.A. which may require 65,000 lb of sedum cuttings; not something that every propagator has on hand! We recently harvested about $800 worth of cuttings from a 4 ft × 8 ft stock bed. Multiple harvests could be expected.

Maintenance. Maintenance should also be considered. Roofs should require as little maintenance as possible. Planting at the right time of the year and choosing plants that cover rapidly are important. Periodic fertilization or weed removal should be minimal. Providing irrigation should be considered, especially in the establishment stage. Water availability will probably be necessary if prolonged drought threatens the roof. However, if plants and media are properly matched, this should be only considered an emergency measure.

Structural Support. Especially for retrofit roofs this issue will be of critical importance. With light-weight media, relatively little increased support may be necessary for new construction

Insurance Laws. In the U.S.A. we are not used to dealing with green roofs. How long will the roof membrane last? It must be installed correctly and be of the highest quality. Will roof plant biomass constitute a potential fire danger? Will only succulents be tolerated? These issues have been worked out in Germany, but are new to U.S.A. builders, roofers, and horticulturists.

SUMMARY

In summary, green roof installation in the U.S.A. is just beginning to take off. Its success, however, will only be insured if the services of diverse groups such as roofers, architects, and horticulturists are brought to bear in the installation. To be successful sealed roofs must be coupled with a light-weight, long-lasting growing media that meets plant demands and yet will slow down storm water as not to over burden municipal sewage systems. Finally, where will the plants come from? These must be supplied by nurseries that work in concert with roofers and architects. This represents an entirely new market for propagators.

New Plants! What's Good for Nurseries?©

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The JC Raulston Arboretum (Raleigh, North Carolina, U.S.A.) continues to acquire and evaluate multitudes of new plants for landscape adaptability and garden performance in the Piedmont of North Carolina (USDA Cold Hardiness Zone 7b). The following plants are but a few of our newer acquisitions, representing continued introductions from many sources including nurseries, other botanical gardens and arboreta, and index semina from abroad.

***Acer oblongum*, smoothleaf maple.** Supposedly an evergreen maple, but one shouldn't believe all that the books say, as our plant has displayed vivid red fall color. In all respects, our plant is correctly identified. This illustrates the inadequate testing that many uncommon species undergo in the U.S.A.

***Spiraea thunbergii* 'Fujino Pink'.** A superior form of a commonly grown spirea in the U.S.A. with better "flower power." Flowers are tinged pink in bud, but open white. Newly introduced from Japan and named after its discoverer.

***Cotinus coggygria* 'Ancot', Golden Spirit™ smokebush.** A wonderful new gold-foliaged selection from the United Kingdom, soon to be released in U.S.A. I have heard reports of fabulous fall color, but have not yet seen this on our plant in North Carolina. The gold leaves neither scorch nor bleach in our humid, hot summers, based on observations over the 2 years we have had our plant.

***Berberis* ×*ottawensis* 'Silver Miles', variegated purple-leaf barberry.** Very interesting gray-mottled variegated foliage. A plant worthy of widespread cultivation.

***Cyrilla racemiflora* 'Graniteville'.** Variation in the wild waiting to be selected, as evidenced by differences in flower form (erect racemes versus pendulous racemes). 'Graniteville' represents a dwarf (or pendulous, if grown in shade) cultivar now available.

***Wisteria frutescens* 'Amethyst Falls' and 'Lynn Lowrey'.** Two excellent cultivars, differing in inflorescence form, representing the emerging importance of this overlooked southeastern U.S.A. native. 'Amethyst Falls' has compact inflorescences produced from spring through summer. 'Lynn Lowrey', newly released