elongated bracts, petal width, and with the perianth bearing a silky pubescence on the abaxial surface of the sepals. Progeny are similar to *Schima* with conspicuously stalked inflorescences, often bearing more than one flower (subracemose), small subequal sepals, elongate peduncles, the number of flowers per inflorescence, abaxial pubescence of the petals, and smaller filament ratio. Progeny exhibit intermediate traits in the length of the tapered leaf base, leaf apex, abaxial leaf pubescence, flower diameter, the free sepal and petal length, sepal width, filament lengths, and filament length ratio. Progeny are typically very floriferous and exhibit an abundance of flowers (10 to 90) per shoot, exceeding either parent (2 to 4 in *F. alatamaha* and 10 to 15 in *S. argentea.* Therefore, this character trait provided the origin of the epithet chosen for the hybrid progeny. The filaments of the hybrids often are malformed and sometimes flattened, enlarged, and petaloid in appearance. Anthers of the hybrids often are nonexistent or malformed and rarely produce pollen. ×*Schimlinia floribunda* Ranney and Fantz (mountain schimlinia) is proposed as the name for these hybrids. Breeding and evaluation of hybrids is continuing in hopes of selecting desirable new introductions.

Green Roof Plants Mitigate Storm Water and Clean the Environment©

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INTRODUCTION

As North America becomes more developed, increasingly large areas of land are being covered with impervious surfaces such as buildings, roads, and parking lots. When storms occur, runoff can impose a significant threat to watersheds locally and regionally. Although green roofs are not new, Germany over the last 30 years has developed extensive green roof technologies that can be applied in the U.S.A. to reduce roof runoff and watershed damage. Green — sometimes called eco — roofs are, as the name implies, thin (4- to 6-inch deep) 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 almost always consists of winter-hardy, drought-tolerant, perennial plants. Although some information about green roofs is available, replicated performance specifics, especially as they relate to roof hydrology or the cleansing effects of green roofs, are mostly patented or proprietary, or anecdotal.

OBJECTIVES

The Center for Green Roof Research at Penn State investigates the performance characteristics of green roofs, particularly as they relate to the quantity and quality of storm water discharged from green roofs.

Table 1. Summary of a rain event.

Start	6/17/03	2:02 PM
End	6/18/03	3:21 AM
Duration (h)	13.32	
Inter-event interval (h)	71.42	
Total rain	1.00 inches	
Runoff non-green	0.863 inches	± 0.066
Runoff green	0.514 inches	± 0.045
Peak Runoff	inches/5 min	Percent of rain
Rain	0.09	100%
Non-green	0.08	88.9%
Green	0.042	46.7%
Percentage runoff		
Non-green	86.3%	
Green	51.4%	
Percentage retained		
Non-Green	13.7%	
Green	48.6%	
Amount retained (green)	0.486 inches	

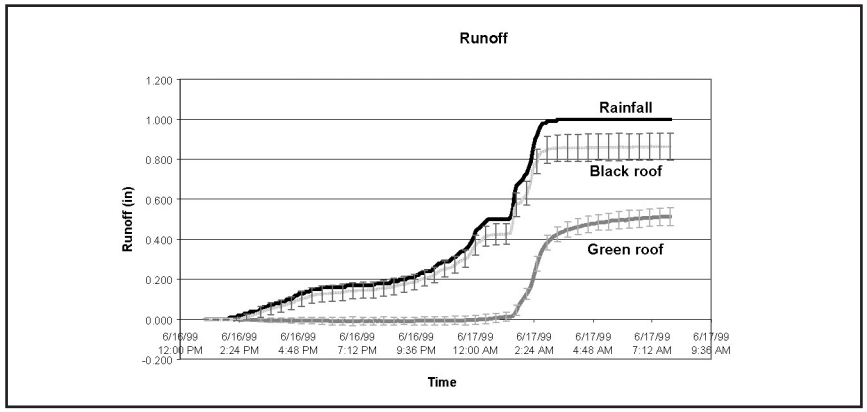

Figure 1. Runoff plot from a rain event on 17 June 2003 (see Table 1).

Table 2. Summary water quality data of runoff from green and non-green (NG) roofs at the Center for Green Roof Research in Rock Springs, Pennsylvania.

	pH		EC		NO_3 (ppm)		Turbidity		Color	
Event	NG	Green	NG	Green	NG	Green	NG	Green	NG	Green
10/11/02	5.5	6.9	0.09	0.09	2.32	1.0				
10/16/02	6.3	7.3	0	0.11	0	0.18				
10/24/02	6.1	7.0	0.05	0.11	1.5	0.47				
10/29/02	5.9	7.3	0.02	0.10						
5/21/03	6.3	7.5	0.02	0.33	2.1	1.1	7.2	3.7		
6/7/03	5.7	7.4	0.04	0.16	3.8	0.38	4.6	2.7	27	550
6/8/03	5.7	7.5	0	0.13	1.0	0.3	9.9	4.4	29	546
6/17/03			0.03	0.16	4.4	0.8	7.1	4.8	30	550
6/20/03					1.42	0.3	10.4	3.1	69	550

METHODS

In May 2000, six small (6 ft × 8 ft) buildings were erected. Three buildings have asphalt roofs and three have been fitted with green roofs. All building have enclosed gutters that are connected to runoff barrels fitted with pressure transducers to measure runoff. Buildings were insulated, equipped with heaters and air conditioners, and instrumented to collect data on storm water runoff. In addition, runoff was sampled for several environmental parameters including pH, turbidity, and nitrates. A Hanna Instruments model HI9813 was used to measure pH, nitrate was measured using a HACH DR890 colorimeter using the cadmium reduction method (Method 8039), and turbidity was measured with a HACH pocket turbimeter model 52600-00. A weather station sited atop one of the buildings provided rainfall, temperature, solar radiation, and wind data. Green roofs consisted of 3.5 inches of an expanded, clay-based mineral placed on top of a drainage layer. Plants were mainly *Sedum spurium* with some *S. album* and *Delosperma nubigenum* and covered 90% to 100% of the surface of the green roofs.

SUMMARY

- Green roofs reduce storm water runoff 50% to 100%. During the summer of 2003 (a very wet summer in central Pennsylvania) the green roof buildings retained about 50% of the total precipitation (Table 1).
- Green roofs reduce peak flow rates for storm water runoff. Runoff is delayed (approximately 20 to 30 min in our test buildings) and the peak flow rate is only about 50% of the peak rainfall rate (Fig. 1).
- Runoff from green roofs contains fewer nitrates, particulate matter, and has a higher pH (Table 2).