wild by design

Growing Grit Trial Garden

Low Nutrient Substrates for Resilient Perennial Planting

With the generous support of the Landscape Architecure Canada Foundation, the Growing Grit trial garden has been established at Athol South Marysburgh Public School in Cherry Valley, Prince Edward County by Ben O'Brien, landscape designer and owner of Wild by Design.

The purpose of the garden is to investigate the potential of aggregate-based artificial substrates as an alternative to conventional planting soil for use in urban public spaces. The research focus is to evaluate the performance of a wide range of native and non-native herbaceous perennials, grasses and bulbs planted into different depths of different artificial substrate mixtures, and investigate which combination of substrate mixture and substrate depth best resist weed invasion.

Preliminary results from the 2018 growing season have shown a very high survivability of planted species (> 90% survival) when regularly irrigated during the first growing season. Substrates with compost fostered the best plant growth, but were more prone to weed invasion. Pure mineral mixtures have shown superior resistance to in-blown weed seed from the adjacent (and very weedy) soccer fields and lawns, but at the expense of plant growth. Most observed weeds were either annual or biennial ruderal species that could easily be managed by 3 or 4 targeted weeding visits per year.

Experimental Design Phase 1 (see trial garden layout)

Phase 1 beds were designed to trial two different palettes of plants. The rationale was to grow as wide a range of species as possible and ensure that taller, more robust plants didn't outcompete or shade smaller, more diminutive species.

The palette planted in beds A1-A4, B1, and B3 feature larger plants with either tall leafy stems or more broadly spreading habits. The palette in beds C1-C4, B2 and B4 is composed of smaller, more typically xeric species such as Geum triflorum and Echinacea pallida. These plants are either very compact mounds (as with Geum triflorum) or had tight clumps of basal leaves with tall leafless flowering stems (as with Echinacea pallida).

Phase 1 beds tested substrates made from crushed concrete, sand and compost in deep beds (8" and 12" deep) as alternatives for soil, and pure aggregate substrates of either concrete or concrete mixed in equal parts with sand in shallow beds (6" deep) as mulches over existing site subsoil. In all cases the existing soil was stripped to varying depths and substrates placed to bring the level back to the original grade. This more closely simulates soil profiles in landscape architecture projects where the original topsoil is often taken away and new soil is imported and placed on top of subsoil or construction fill. In the deep beds the substrate is more fertile and moisture retentive, so plants can likely survive without rooting into the underlying subsoil. In the mulched beds plants will likely need to root into the underlying subsoil to survive. Subsoil at the test site was very coarse granular sand.

Experimental Design Phase 2 (see trial garden layout)

Phase 2 was more focused on testing a wider range of substrate mixtures, so the plant palette was kept the same in all 22 new beds. The species included some from Phase 1 as well as new species and bulbs. It will be especially valuable to note how plants in the Phase 2 beds, planted in early September, overwinter after a shorter growing season.

Building on the success of the Phase 1 beds, substrate mixtures in Phase 2 experimented with roughly the same ratio of aggregate to compost, but explored alternative aggregate materials including high performance bedding (limestone screenings with no dust or fine particles), 3/8” crushed limestone and 3/8” granite pea gravel. The aggregates trialled have very different material costs, with 3/8” crushed limestone being the cheapest and granite pea gravel as the most expensive (almost quadruple the cost of limestone). This has obvious implications for the application of these substrates to real-world landscape practice. Some of the Phase 2 beds were mulched with a thin layer of pure aggregate over the aggregate / compost mixture, while others were filled to the surface with the aggregate / compost mixture. This will test whether a thin layer of coarse aggregate (3/8” crushed limestone or 3/8” granite pea gravel) helps reduce the germination of in-blown weed seeds.

Initial Results: Phase 1

When evaluating plant establishment and growth the Phase 1 beds have been very successful. The only major plant failure came from Sedum telephium ‘Matrona’. This seems more due to poor plant quality than an adaptability to the low-nutrient substrate. Sedums are common green roof plants and typically show high tolerance of drought.

Certain plants performed poorly in some situations without failing entirely. They may have failed completely without the supplemental irrigation they received, and it will be interesting to see how they perform in 2019 with no additional irrigation. Notably the Eriogonum ‘Little Rascal’, and Monarda ‘Claire Grace’ suffered when planted into the pure concrete mulch in bed B1. This may be due to the small plant size (plug size) at the time of planting, or intolerance to the highly alkaline nature of the concrete mulch. Oenothera fruticosa ‘Fireworks’ showed very minimal growth across all beds, but appears to have formed tight rosettes of basal foliage for increased growth next year. The Liatris aspera planted in bed B4 didn’t grow at all after planting and appeared to decline in late summer, early autumn.

Aside from the Sedum ‘Matrona’ failure and occasional plants performing poorly in the harsher pure aggregate mulches, all other plants survived or thrived. The most notable successes include Achillea millefolium, Agastache ‘Blue Fortune’, Callirhoe involucrata, Monarda bradburiana, Monarda fistulosa ‘Claire Grace’, Nepeta ‘Joanna Reed’, Panicum virgatum ‘Shenandoah’, Perovskia atriplicifolia, Ratibida pinnata, Salvia nemorosa ‘Caradonna’, Schizachyrium scoparium, Solidago ptarmicoides, Solidago shortii ‘Solar Cascade’, Symphyotrichum oblongifolium ‘Raydon’s Favorite’, and Symphyotrichum oolentangiense.

Initial Results: Phase 1 (continued)

In evaluating weed invasion it became clear especially later in the summer that the beds where compost was included in the substrate at surface level experienced higher rates of weed invasion and weeds grew more quickly and lushly than on beds mulched with a 1:1 layer of crushed concrete and sand. The concrete and sand mulched beds weren't immune from weed invasion, but weeds grew much more slowly. Most weed species were either quick growing annuals or biennials like foxtail grass, or common garden weeds like dandelion. Annual and biennial weeds are easily managed as long as they don't have the chance to flower and set seed, but weeds with deep tap roots pose greater problems and require physical removal. The most notable result in terms of weed invasion came from the smaller B beds. Beds B1 and B2, mulched with 6 inches of pure crushed recycled concrete experience no weed invasion at all over the entire growing season. Upon very close inspection in October a few miniscule seedlings, less than 1cm tall, could be observed, but these would hardly pose a problem to the plant community and are unlikely to survive long enough to flower and set seed. The small B beds mulched with a 1:1 mixture of concrete and sand were also very resistant to weeds, although a few occasional small plants were removed over the course of the growing season. The success of the concrete mulch is likely due to its high alkalinity, coarse particle size, and rapid drainage which ensured the surface never stayed moist for a prolonged period of time.

Initial Results: Phase 2

While it's generally too early to speculate on the success of the Phase 2 plantings, most plants showed signs of new growth within the first month post-planting. This is generally consistent with the Phase 1 beds, which began to show signs of new growth approximately two weeks to one month after planting.

In terms of weed invasion, a few very small weed seedlings have already been observed in the beds where the substrate contains compost at the surface. Beds mulched with 1-2 inches of aggregate show no initial signs of weed seedlings.

For every facet of measurement in the Phase 2 trial plots, more definitive results will come after the 2019 growing season.

Conclusion

After only one growing season the Growing Grit trial garden has yielded some interesting and valuable information about the performance a wide range of herbaceous perennials and grasses on different low nutrient mineral substrates. While research is well-established and ongoing in Europe, these ideas have yet to be tested in any great depth in a Canadian context. Thanks to grant funding from the Landscape Architecture Canada Foundation the Growing Grit project will continue in 2019 and beyond to investigate the potential of planting in low nutrient mineral substrates, and hopefully encourage the greater adoption of beautiful, biodiverse and resilient perennial plant communities in Canadian designed landscapes.

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Phase 1: 12 trial plots, 352 square feet, planted May 2018

Phase 1: tall perennial trial (photo: August 2, 2018)

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Phase 2: 24 trial plots, 384 square feet, planted September 2018

Phase 1: short / xeric perennial trial (photo: August 2, 2018)