Expanded Shale as a Soil Amendment for Colorado Soils

Cassey Anderson, Graduate Student | Dr. Jim Klett, PhD | Department of Horticulture and Landscape Architecture, Colorado State University, Fort Collins, CO 80523

Introduction

Soil amendments are used to improve soil condition in landscapes, and enhance plant growth in containers or green-roofs. Amendments improve water use and nutrient absorption in part due to their ability to make changes in soil porosity, tilth and hydraulic conductivity. In general, organic amendments are excellent for sandy soils while inorganic amendments can boost plant performance in heavy clay soils. Clay soils have low porosity and high potential for water logging. In containers, inorganic amendments also reduce weight and bulk density improving porosity. Similarly, green-roof construction relies on the addition of lightweight inorganic materials to provide substance and drainage while reducing the weight imposed on the roof.

Expanded shale is a construction material more recently marketed as a horticultural soil amendment to aid in water retention and aeration of soil. Expanded shale is produced by heating mined shale rock to 2000 ºC causing fracturing and micropores which can hold moisture and nutrients in the soil profile. This product, unlike organic amendments, does not break down over time and is permanent in a landscape soil. Expanded shale is lightweight, with a density about half that of other amendments such as pea gravel.

Currently expanded shale is not commonly used in Rocky Mountain area landscapes and if proven beneficial it could be an important use of this construction material. This research examined the effects of expanded shale on growth of two landscape plants in an irrigated bed with clay loam soil.

Purpose

Expanded shale (Fig. 1) may aid plant growth in clay soils through changing water and nutrient bioavailability and soil aeration. Performance of plants in clay soils amended with expanded shale had not been tested in Rocky Mountain area landscape conditions. Consequently, field plots were established in 2015 to test the efficacy of the lightweight expanded shale as a soil amendment.

Fig. 1 Expanded shale Amendment.

Fig 2. Plot sites:
Soil amendments, Oct 2015.
Plant transplant, November 2015 and April 2016.

Materials & Methods

Treatments were clay loam soil with:

No shale and 2 " compost	(C-2)
1 " shale with 2 " compost	(S1, C-2)
2 " shale with 2 " compost	(S2, C-2)
3 " shale with 2 " compost	(S3, C-2)
2 " shale only	(S2)
3 " shale only.	(S3)

Treatment	pH	EC mmhos/cm	OM	Nitrate	K	P
C2	7.6	1	5.3	0.93	3484	120
S1C2	7.9	1.1	4	1.4	231	77
S2C2	7.8	1.1	4.8	2.2	270	93
S3C3	7.8	1	5.7	1.4	242	74
S2	7.9	1.3	3	11.7	266	91
S3	8.2	1.1	2.4	7.7	237	53
unamended soil	7.6	2	3.1	64	374	89
compost	6.5	2.1	30	412	2415	528

Fig. 3 Soil test results for treatments

Plants were *Heuchera sanguinea* 'Snow Angel' coral bells and *Penstemon x mexicali 'P008S'* Red Rocks® penstemon. Soil was amended with compost comprising of peat moss, composted bark, chicken manure and pumice.
Each plot was 8.0 x 5.5 feet. The six treatments had five replicates.
Sets of measurements taken through 2016 and 2017 growing seasons include:

1. Physical growth measurements, one height and two widths to get a solid width average
2. Easy Leaf Area imaging system to assess growth at regular intervals
3. Soil moisture readings (taken in October 2016 and weekly in the 2017 growing season).
4. Soil moisture measurements taken once in 2016 and weekly in 2017 with a moisture meter.

Fig. 4 *Heuchera sanguinea* 'Snow Angel' and *Penstemon x mexicali P008S* 'Red Rocks'.

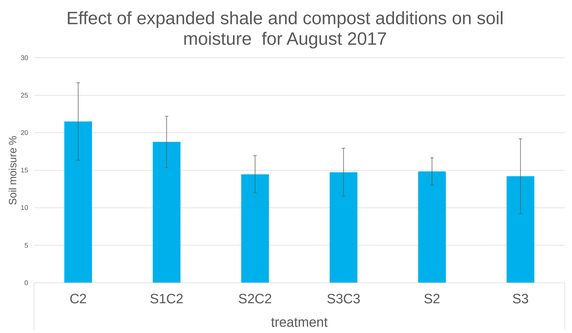

Fig. 5 averaged moisture readings over six treatments in August 2017

Results

Monthly measurements of width at two directions and height did not show differences in the six treatments for either the *Heuchera* or the *Penstemon* (Fig. 6).

Leaf surface area Digital Images of each plant were taken monthly and processed for leaf surface area by the program "Easy Leaf Area". Easy Leaf Area data is still being analyzed and is not shown, early problems with the program include leaf size variability, leaf color and flower color leading to complications with calibrations for the program. The outside setting of this study has proved problematic for uniformity of data from the program.

Moisture readings demonstrate that water is retained more with compost only amendment than with expanded shale, so plants that need better drainage could benefit from amendment with this material.

Soil analysis shows that there is no effect of the expanded shale treatments on the nutrient or micronutrient levels of the soil profile when compared to unamended soil.

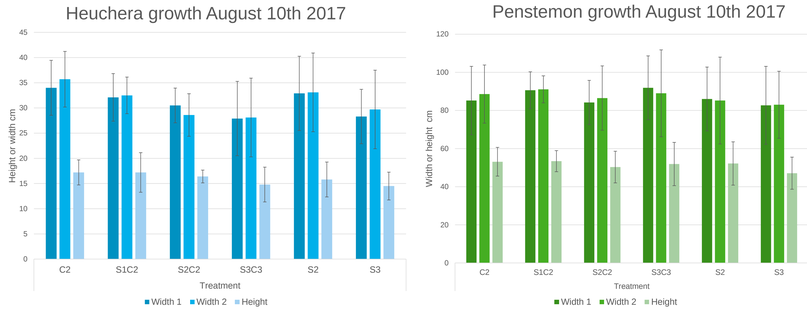

Fig 6. August 2017 averaged growth of plants between five replications.

Conclusions

After two growing seasons (April through September 2016 and 2017) there were no visual differences between treatments or plots (see Fig. 6). The two plants had different growth morphologies. *Heuchera sanguinea* 'Snow Angel' had a round compact leaf mass with flowering as extended stalks peaking in early June,. *Penstemon x mexicali P008S* 'Red Rocks' had a sprawling growth habit with flowers directly on the branches and flowered throughout the growing season with a first flush in June.

The lack of an effect of compost on growth could be explained by a uniform fertilizer treatment in the first year of the study. Watering was adequate throughout the experiment. The heuchera did experience drought symptoms in June 2017 likely due to a sudden onset of extreme heat which slowed its growth. The slope of the site ensured good drainage although there were slight moisture differences between treatments seen in 2017 data (see Fig 5).

Noted was a greater ease of weeding in the plots with added expanded shale. The expanded shale amendments had no negative impact on growth of *Heuchera* or *Penstemon*.

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