

**Michigan Department of Agriculture and Rural Development
HORT Fund
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Project Title: Seasonal Fate of De-icing Sodium Chloride Applications in Roadside Raingardens and Its Implications on Vegetation

Project MDAH #: 791N6600409

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Reporting period: 6/1/16 – 8/15/17

Accomplishments during reporting period:

Raingardens are designed to improve water quality by reducing the speed of runoff and by limiting the amount of pollutants that enter surface and drinking water supply. Preliminary investigations in the Lansing area during the 2013-2014 winter, indicated that sodium and chloride concentrations in roadside raingarden soils showed a steep increase from December to February. Concentrations on Michigan Ave. raingardens in February were approximately 400% higher than in the Towar residential area.

Raingardens were examined in downtown Lansing, MI along Michigan and Washington Avenues, in the Towar neighborhood in Bath, Michigan and at the Farm Lane/Service Road Bioretention site on the Michigan State University campus. All raingardens, therefore sampling, was on public property. The raingardens along Michigan and Washington Avenues were completed in 2008 as a part of the city's efforts to separate storm and sewer systems. These raingardens drain concrete walks and asphalt roads with heavy vehicular and pedestrian traffic and are long and narrow with flat bottoms and vertical side walls.

The Washington Ave. raingardens are located at street corners adjacent to angled street parking stalls. These raingardens are constructed with a vertical concrete wall along the sidewalk. The side closest to the road has curbs and a vegetated rim that slopes down to the bottom. Surface water drains through curb cuts into the raingarden. The shape of the Washington Avenue raingardens allows for sampling at the rim and bottom. The rim is defined as the curb level on the roadside perimeter of the raingarden. Three raingardens were evaluated along Washington Avenue.

The raingardens in the Towar neighborhood receive water directly from asphalt roads with no curbs, residential lawns and in some locations, sidewalks. These raingardens are long, narrow and have sloping vegetated side walls. They were constructed in 2006 and 2007 as a less expensive alternative to the failing traditional stormwater system. The Towar neighborhood raingardens receive the least amount of vehicular and pedestrian traffic. Birch Run is the main thoroughfare in the Towar neighborhood running east and west. Towar Ave. is the main

thoroughfare running north and south. Secondary streets that receive less vehicular traffic are off Birch Run and Towar. Raingardens were evaluated on the north and south sides of Birch Run and on the east and west sides of Towar Ave. and the secondary streets.

The FarmLane/Service Road Bioretention Site on the Michigan State University campus was constructed to handle the stormwater from the Farm Lane railroad underpass. Stormwater from Farm Lane is pumped into a cistern and periodically discharged into the basin, filtered and subsequently discharged into the greater stormwater management system. The site consists of two basins, the first flush discharge basin and a second biofiltration basin. A sample was taken from the first flush basin and two samples from the biofiltration basin.

Objective 1

To identify the seasonal presence of sodium and chloride in the upper layers of soils in roadside raingardens.

Soil samples were taken in July to determine whether remnant sodium and chloride levels could still be present from the 2016 winter season. Sodium levels in the Michigan Ave. raingardens averaged 374 ppm. Chloride levels averaged 290ppm. These levels dropped to 93ppm sodium and 61ppm chloride in August and 90ppm sodium and 54ppm chloride in October. Data indicates that soil levels of sodium and chloride related to deicing salts could last into the summer months. By August, levels appearance to drop to its lowest levels of the season. July sodium and chloride levels in the Washington Ave. raingardens were 121ppm and 351ppm respectively. These levels dropped to 22ppm and 66ppm in August. Average levels of sodium and chloride in the Towar raingardens in July was 150ppm and 227ppm respectively. August levels dropped to 84ppm sodium and 74ppm chloride. Sixty two ppm sodium and 379ppm of chloride were found in the Farmlane/Service Road Bioretention site in July. October levels of sodium were 78ppm and chloride level dropped to 113ppm. The increase in sodium from July to October could be due to where in the basin that the sample was taken in October.

Soils samples taken in March provide representative levels of sodium and chloride due to deicing salt application during the 2016/2017 winter season. Michigan Ave levels were 730ppm sodium and 172ppm chloride. Washington Ave raingarden exhibited 738ppm sodium and 128ppm chloride. Towar exhibited 158ppm sodium and 77ppm chloride. The mild winter of 2016/2017 and early spring rains contributed to the lower level in the Towar neighborhood. The MSU bioretention site also exhibited lower levels in March, 55ppm sodium and 88ppm chloride.

Objective 2

To determine the uptake of sodium and chloride in vegetation (tissue analyze) and its influence on plant performance (growth and aesthetics).

Plant species evaluated:

Hibiscus moscheutos, Rose Mallow

Hypericum prolificum, Shrubby St. Johns Wort

Iris virginica, Blue Flag

Rudbeckia hirta, Black-Eyed Susan

Panicum virgatum, Switch Grass

Anemone canadensis, Canada Anemone

Oenothera missouriensis, Ozark Sundrop
Eutrochium maculatum, Joe-Pye Weed
Phlox divaricata, Woodland Phlox
Hemerocallis 'Stella D'Oro, Stella D'Oro Daylilly
Tradescantia ohiensis, Spiderwort
Phalaris arundinacea, Reed Canary Grass
Carex vulpinoidea, Fox Sedge

Plant Tissue samples were taken in July, August and October 2016 to establish a baseline concentrations during the active growing season. Due to the typical maintenance practices of Ingham County, October stem samples were limited. The 2016 plant tissue samples were compared with sodium and chloride levels in May of 2017 following winter salt applications. Average sodium concentration across all species in July, August and October was 0.12ppm, 0.12ppm, and 0.10ppm respectively. Average chloride concentration across all species during the same period was 0.37ppm, 0.31ppm and 0.19ppm. In May 2017 average sodium concentration was 0.20ppm and chloride concentration was 0.72ppm. The level of both sodium and chloride approximately double in the plant tissue sampled from the rain gardens. However, there was little to no evidence of any ill effects on the plant appearance when evaluated in June of 2017. Notable increases in sodium were found in Hypericum prolificum roots (pre-winter level 0.12ppm to 0.46 ppm post winter); Iris virginica roots (0.25ppm pre-winter to 0.94 ppm post winter); and Phlox divaricata stems (0.10ppm pre-winter to 1.22ppm post winter). Increases in chloride concentration was found in Hibiscus moscheutos stems (0.29ppm to 1.45ppm); Iris virginica stems (0.70ppm to 2.00ppm); Eutrochium maculatum stems (0.71ppm to 1.94ppm); and Carex vulpinoidea foliage (0.18ppm to 1.24ppm). Evidence suggests that these plants have the ability to absorb these chemicals with little to no impact on appearance or performance in the rain gardens.

Objective 3

To investigate the influence of sodium chloride on raingardens in municipal, commercial and residential sites with varying pedestrian and vehicular traffic.

The levels of sodium and chloride found across the four raingarden locations provides a reasonable picture of differences in deicing salt use on urban and suburban sites.

Understandably, deicing in downtown urban areas is critical in maintaining safe streets and pedestrian walkways. Raingardens in these areas of Lansing are able to withstand the exposure to salt and provide an aesthetic relief through the quality and performance of their respective plant materials.

Impacts:

Coupled with supplying plants and materials, the Michigan Nursery and Landscape Industry designs, installs and manages this stormwater management technology. Given the extent of de-icing salts used nationally in temperate areas, the results of this research has wide scale reach and relevance. Results will be translated into a trade publication and extension fact sheet on de-icing salts and raingardens. Impacts will be assessed through evaluation forms distributed at workshops, a follow-up survey of participants and through requests for information as a result of website postings of the publication and fact sheet.

Funding partners:

Project GREEN, Michigan State University

Publications/ outreach activities related to project:

Results will be presented at Michigan Nursery and Landscape Association Chapter meetings around the state. A presentation will be given at the 2018 Great Lakes Trade Exposition in January 2018. Presentations are scheduled for November, 2017 in Grand Haven and February, 2018 in Macomb. An article is being prepared for publishing in the Michigan Landscape during the spring of 2018