March 20, 2019

# TECHNICAL BULLETIN

## FOR TARGET MARKET ROOFING

Sarnafil BUILDING TRUST

**Subject: Root Resistance Testing of Sarnafil® Membranes** **19-01**

Root resistance testing was successfully completed for Sarnafil G 476 and Sarnafil G 410 membranes at the Center of Green Roof Research at The Pennsylvania State University.

The testing followed the procedures described in “Investigating resistance to root penetration at green-roof sites” (FLL, 2002) and ANSI/GRHC/SPRI VR-1 2011.

As noted on page 5 of the Results summary section of the attached report, “No roots penetrated the membranes or the seams or the corners and side walls of the test assemblies.” The test was conducted over a 2 year period.

# Green Roof Water Proofing Root Resistance Evaluation for Sika Corporation Sarnafil G 476 and G 410 Membranes

Center for Green Roof Research, Plant Science Department, The Pennsylvania State University

# Center for Green Roof Research

## Final Report Summary

**Test Procedure:**

Green Roof membranes were tested for root resistance to Pyracantha and Quack grass in a greenhouse study following test procedures described in "Investigating resistance to root penetration at green-roof sites" (FLL, 2002) and ANSI/GRHC/SPRI VR-1 2011.

**Manufacturer:**

Sika Corporation (Sarnafil membranes)

Materials Tested:

1. Sarnafil G 476
2. Sarnafil G 410

### Results summary:

1. The Sarnafil G 476 and Sarnafil G 410 membrane systems tested in this evaluation are resistant to root and rhizome damage based on this greenhouse test.
2. Plant growth was equivalent in test and control containers and was adequate for proper test evaluation. Dense root mats were evident at the bottoms of all test and control containers. There were no differences in plant growth or root density in test or control containers.
3. No roots or rhizomes penetrated the membrane on the bottoms or sides of any of the test containers.
4. No roots or rhizomes penetrated the corners or vertical sidewalls of any of the test containers.
5. Fine roots adhered to the membrane surfaces and some seams but did not penetrate and were easily washed or rubbed off. Roots stained the membrane surfaces, particularly of the G 410 roofing membrane but there was no apparent damage to the membrane.

# Sika Sarnafil Waterproofing Green Roof Root Resistance Test Final Report

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**Introduction:**

**Background**: Greenroof membrane resistance to root, stolon and rhizome damage is critical to the successful application of this technology. The FLL in Germany developed a protocol for "Investigating resistance to root penetration at green-roof sites" (FLL, 2002). The original procedure has been revised several times and the current procedure is recognized by manufacturers, planners and roofing contractors in Germany. This procedure was used as the basis for developing a ANSI/GRHC/SPRI testing protocol VR-1 (2011) for use in North America. The basic Penn State procedure followed in this evaluation is based on the ANSI/GRHC/SPRI VR-1 methods.

**Test Applicability**:

This testing procedure is intended to evaluate resistance to normal root and rhizome penetration of materials to be used for intensive or extensive green roofs including:

Root barriers
Roofing membranes and waterproofing materials

The test procedure also evaluates seaming and jointing used with the test material.

**Limitations**:

The test procedure only evaluates the top surface layer of the material to be tested where the membrane is composed of multiple layers of different materials. Materials included in the membrane system that are not exposed to roots are not evaluated in the test.

Test procedure does not include evaluating resistance to penetration by aggressive plant species such as Bamboo.

Test procedure does not evaluate waterproofing suitability, environmental compatibility of, or long term stability of, any products tested (i.e. resistance to temperature, UV light, microbial decomposition, etc).

**Testing Protocol**:

**Materials and facilities:**

**Test containers:** Containers were constructed as described in the ANSI/GRHC/SPRI VR-1 protocol with dimensions of 800 mm x 800 mm x 250 mm (31.5" x 31.5" x 10"). Containers were metal with a clear plexiglass bottom.

**Container numbers:** The test included 6 replicates (test containers) of each of the Sarnafil G 476 and Sarnafil G 410 membranes and 3 containers used for controls which did not contain a membrane.

**Landscape fabric**: (*Protective nonwoven fabric*). Non-woven landscape fabric made of synthetic fibers was used in control containers in place of the test membrane material.

**Test materials:** Test membrane materials were supplied and installed in the test containers by the manufacturer at the test site. Materials were applied based on the manufacturers normal application procedures. The seams, corners and vertical sidewalls were installed as per the manufacturers standard methods. A sample of the test material has been retained as a reference sample. This sample will be stored in the dark at a temperature between 5 and 25°C for 5 years after the completion of the test along with this report and sufficient product information and specifications to allow identification of the product.

**Substrate:** Vegetation substrate was a commercial sphagnum peat based greenhouse or nursery potting substrate (Sunshine #4*)*.

**Fertilizer:** Slow release fertilizer with complete macro and micro-nutrients (Osmacote Plus 15-9-12 with a release over 6 months) was applied as needed. In addition a liquid fertilizer 20-10-20 at 200 ppm N was applied as needed through an injector to maximize plant growth.

**Tensiometer:** A tensiometer was used as needed to monitor water status in the containers. Irrigation was applied using hand watering as needed.

**Test plants:** Two species were used in each container. 1) *Agropyron repens* (AKA *Elymus repens*) – quack grass; a fast growing grass with a fairly aggressive rhizome that is a common weed on many green roofs. 2) Pyracantha coccinea – a rapidly growing shrub. Five Pyracantha and sufficient grass plugs, or rhizomes to cover the container (i.e. 4-5 plugs per test container) were used.

**Greenhouse:** Greenhouse facilities at the Pennsylvania State University, University Park, PA were used to provide for year-round growth. Heating and ventilation were provided as needed. Heating set points of 16°C Night temperature, and 18°C Day temperature and a ventilation set point of approximately 22°C were used. Test containers were provided adequate greenhouse space to ensure good plant growth.

**Methods:**

**Test system assembly:**

Membranes were installed by Sika Sarnafil as specified in the ANSI/GRHC/SPRI VR-1 protocol. Boxes 1-6 contained the Sarnafil G 476 membrane**.** Boxes 7-12 contained the Sarnafil G 410 membrane and 13-15 were controls with no membrane used. The test treatments were flood tested after the membranes were installed and repaired on site by the manufacturer as needed. Test boxes were filled with media and planted. Each container was filled to within 50 mm of the top edge with the growth media, and plants were installed. Pyracantha were equally spaced approximately 200 mm from the corners of the container and in the center, grass plugs were planted between the pyracantha.

**Control test container assembly:**
The 3 control assemblies were constructed without root barriers, instead, a layer of landscape fabric was used under the growth medium. Medium and plants were installed as with the test systems.

**Plant growth and monitoring:**
Plant growth was monitored over the test period. Height and width of both control and test system pyracantha and grass were observed and plants were rated for condition on a 1 to 5 scale. Plant growth was excellent throughout the study. Roots were visible at the bottom of control containers within 2 months of planting. A dense mat of visible roots was maintained at the bottom of control containers throughout the study period. Plants had covered the surface of the containers within 3-4 months of the start of the test. Coverage was maintained throughout. There were no differences in growth between plants in test containers with Sarnafil membranes and control containers. Pyracantha was cut back periodically to maintain access through the greenhouse aisle ways for container watering and evaluation. The assumption of normal growth in the test systems was met based on the observation that the average growth of control and test system plants varied by less than 20% and average plant condition evaluations varied by less than 1.5 units.

The test material at the bottom of the container was examined through the plexiglass base of the container throughout the test period. There were no roots visible in any of these observations during the test period in the test containers. Roots were clearly visible in control containers within 2 months of planting.

Irrigation was terminated 2 weeks before the test was terminated to dry the media to facilitate emptying the boxes of plants and evaluation of the root barriers.

At the end of the test (7/25/2018), the test was terminated. Test boxes were emptied of plants and growth medium and the surface of the test material was evaluated for root and rhizome damage. Any evidence of root or rhizome damage, adhesion, or penetration was recorded. Final evaluations and inspections were done by Dr. Robert Berghage, Penn State Center for Green Roof Research and observed and assisted by Gary Whittemore, Sika Corporation.

**Sarnafil G 476 and Sarnafil G 410 membranes root resistance evaluation:**
Test and control boxes were tipped on their sides and the bottom of the test system was closely evaluated for evidence of roots. There were many root traces visible with the control boxes (Figure 1). There were no roots or rhizomes visible through the plexiglass of the test boxes. Plants and media were removed from the test boxes by flipping them over and lifting off the test boxes and the membrane assemblies. In all cases the media and root masses were easily removed from the membrane assemblies. There were large numbers of roots observed on the bottoms of control test boxes (Figure 2). There were no roots or rhizomes evident on the outside of the bottom or sides of any of the test membranes (Figure 3,4). The corners and sidewalls were examined closely and no roots or rhizomes were observed to have penetrated the corners or vertical sides or the membrane assemblies. The membrane assemblies were easily pulled away from the media and root mass suggesting that there was no serious root attachment to the membranes. There were large masses of roots and many rhizomes at the bottom of the media and

along the sides where they had been in contact with the membrane (Figure 5,6). Some media was stuck on the membranes after the primary root mass was removed. Close examination of the surface of the membrane revealed some fine roots stuck to the surface. These fine roots and media were easily removed by washing or rubbing. Close examination of the surface revealed that there was no penetration or obvious damage to the membrane surface. The white surface of the membrane (Sarnafil G 410) was stained brown or grey by roots and media (Figure 7). Some of the brown stains were not easily washed off. There was much less staining of the orange surface of the Sarnafil G 476 membrane and what staining there was, was more easily washed off (Figure 8). Some roots were found to be tightly attached to some of the seams of the membranes. Close examination reviewed that these roots did not penetrate the sealed seams but were attached to the surface of the weld (Figure 9). There was excellent root growth and large root mats on the bottoms of all test containers.

**Summary and Conclusions:**

**Results summary:**

1. Plant growth was equivalent in test and control containers and was adequate for proper test evaluation. Dense root mats were evident at the bottoms of all the assemblies. Dense root mats were observed at the bottoms of control containers.

2. No roots penetrated the membranes or the seams or corners and side walls of the test assemblies.

3. Fine roots stuck to the surface of membranes, but were easily washed or rubbed off. The membranes were stained by some of these roots but there was no evidence of damage to the membrane when examined closely.

**Conclusions:**
Sarnafil G 476 and Sarnafil G 410 membranes, resisted root and rhizome penetration by quack grass and pyracantha during a 2 year test period.

Tested System
Sarnafil G 476 and Sarnafil G 410 membranes

This report serves as certification that the test was conducted as described in this procedure and that the results obtained are as reported.

The Penn State Center for Green Roof Research in no way warrants (expressed or implied) the products tested, only that the test was conducted as reported and the results of the test were as stated in this final report. The Center for Green Roof Research retains the right to summarize and publish results of this test, however manufacturer identification, or proprietary product specifications will not be disclosed without express permission.

**FIGURE 1. CONTROL BOX AT HARVEST SHOWING ROOTS VISIBLE THROUGH THE PLEXIGLASS**

**FIGURE 2. TYPICAL CONTROL ROOT MAT AFTER THE TEST BOX WAS REMOVED WITH THE FABRIC LAYER STILL ATTACHED**

**FIGURE 3. OUTER MEMBRANE SURFACE OF TYPICAL SARNAFIL G 476 MEMBRANE AT HARVEST.**

**FIGURE 4. OUTER MEMBRANE SURFACE OF TYPICAL SARNAFIL G 410 MEMBRANE AT HARVEST.**

**FIGURE 5. TYPICAL ROOT MAT OBSERVED ON THE BOTTOM OF THE SARNAFIL MEMBRANE TEST BOXES**

**FIGURE 6. TYPICAL RHIZOME GROWTH ALONG THE SIDES OF SARNAFIL MEMBRANE TEST BOXES**

**FIGURE 7. SARNAFIL G 410 MEMBRANE SURFACE AFTER THE MEDIA AND PLANTS WERE REMOVED. SOME MEDIA AND SOME FINE ROOTS STUCK TO THE SURFACE HOWEVER THEY WERE EASILY WASHED OR RUBBED OFF. SOME STAINING WAS OBSERVED.**

**FIGURE 8. SARNAFIL G 476 MEMBRANE SURFACE AFTER PLANTS AND MEDIA WERE REMOVED. ALTHOUGH THERE WAS SOME STAINING OBSERVED MOST WAS EASILY WASHED OFF.**

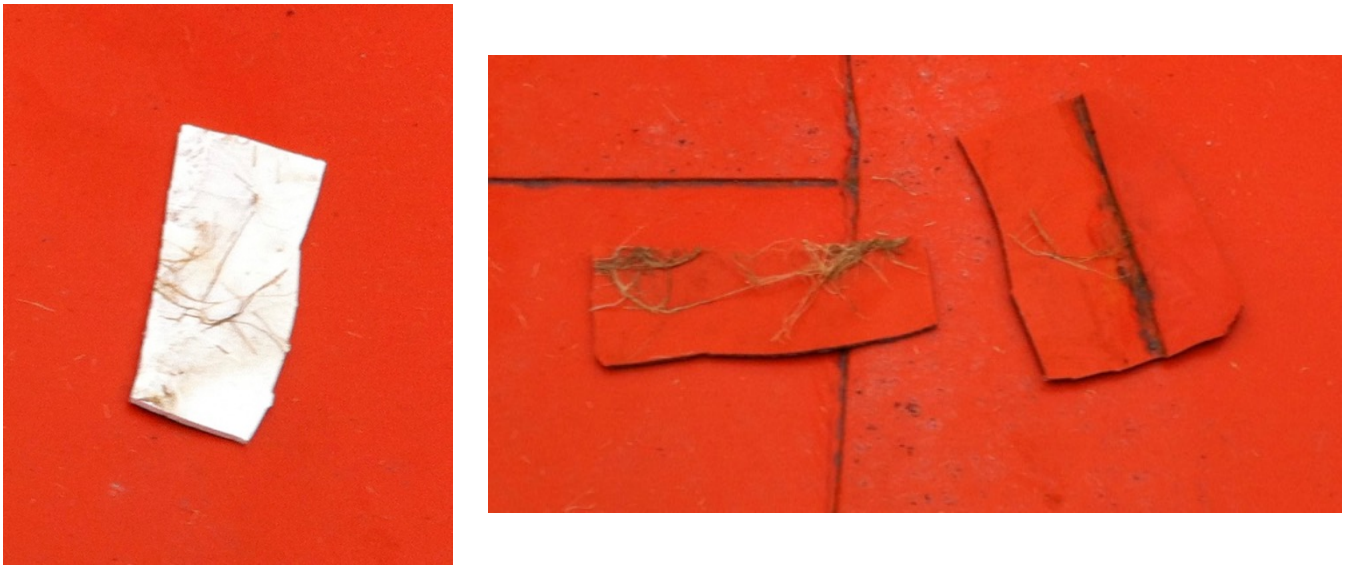

**FIGURE 9. ROOTS ADHERING TO THE SURFACE OF THE MEMBRANES OR THE EDGES OF THE SEAMS. MICROSCOPIC OBSERVATION INDICATED THAT NONE OF THESE PENETRATED THE SURFACE OF SEAMS.**