

Greenroof and Greenwall Maintenance

By

Robert Long, President – Carolina Stonecrops, Inc.

www.greenroofplants4u.com

And

Gregory Long, President – Capitol Greenroofs, LLC

www.capitolgreenroofs.com

Updated on October 2013

Greenroof Maintenance Index

1. Introduction

- Low maintenance not NO maintenance
- Custom maintenance to meet roof uses
- Custom maintenance materials to meet customer needs

2. Roof maintenance safety requirements

3. General roof housekeeping

- Drain cleanout
- Swamps
- Loose flashing

4. Nutrients and supplements

- Fertilizer
- Biologicals

5. Disease prevention and cures

- Bad funguses
- Preventative treatments
- Cure outbreaks

6. Pests

- Above ground (snails, slugs, grasshoppers, birds)
- Below ground (mealy bugs, sow bugs, centipedes)

7. Weeds

- Prevention
- Removal

8. Irrigation

- Stonecrops are drought tolerant not desert plants
- CAM mechanism
- Water is critical in feeding plants

9. Plant fill-in and replacement

- Small areas - use cuttings
- Large area – use plugs

10. Greenwalls

11. Summary

1. Introduction

This book is meant to be a practical manual to be used by homeowners, landscapers and in-house maintenance people on how to maintain the greenroof that they are responsible for. Every greenroof owner has different objectives that they want to accomplish with their particular roof. To this end we have included everything we can think of for producing greenroofs that meet all the objectives typical to greenroofs. Not all of these maintenance procedures may be applicable to your roof. For example, some owners may not want to use fertilizers or organic chemical fungicides on their roof. In these cases, we have offered alternate methods for improving fertility and fungus control.

1.1 LOW Maintenance not NO Maintenance:

Since greenroofs have been used in Europe, sedums and ice plants have been predominantly used in the extensive parts of the greenroofs because of their low maintenance attributes. They are low growing, rapidly maturing perennials, that have both a high capacity to hold water and really good drought and cold weather tolerance. In addition they are available in many interesting shapes, many flower and most change color through the seasons. These stonecrop plants were previously used mostly for rock gardens and come from all over the world. Under most conditions these plants are considered to require a low amount of maintenance to keep them alive and looking well. However, what was low maintenance on the ground in a rock garden (with plants worth a few dollars) soon became no maintenance when they became harder to access on rooftops. However when you consider that greenroofs often have several thousand dollars worth of plants and labor invested in them and are often used for rooftop gardens/parks, ***then no maintenance is not really an option.***

Although these gardens are on roofs they still fall prey to weeds, pests, extended droughts and diseases. In addition the rooftop is a very hot, windy hostile environment for the plants despite their toughness.

1.2 Custom maintenance to meet roof uses

Not all greenroofs are put on for the same reason(s). A greenroofs primary objective(s) may be the following:

- Minimization of stormwater run-off
- Research on greenroof removal of pollutants from rainwater
- Providing a natural park like area on a downtown building
- Sound attenuation on a building near an airport
- Increasing the insulation on a building (lower utilities)

The primary objectives may effect what type of maintenance is done on that particular roof. For example, the plants may not have to look their best if they are on the top of a power plant or if they are not seen close up from other buildings.

Remember that the maintenance methods mentioned in this book may be overkill on some roofs and not be needed or wanted by the owner of the roof.

1.3 Custom maintenance materials to meet customers/owners needs

As mentioned in the beginning, some of the materials or chemicals may not fit the need/objectives of the roof owner. In each chapter we will be making recommendations of materials that are most effective but may not be appropriate for that particular roof. We have tried to stay away from nasty chemicals or complicated system that may be awkward to use on the confined space of the roof. In the end it will be up to the workers to decide with the owner as to which materials to use.

1.4 Preventive versus Reactive maintenance measures

As with any maintenance programs there are both preventive and reactive programs. We will endeavor to outline a preventive program that minimizes cost and time in favor of the reactive approach. For example, it is far cheaper to remove weeds biweekly during the summer than to let them spread weed seeds on the roof and then pull the adult weeds at the end of the summer. Many aspects of the maintenance program can be done simultaneously such as weeding, fertilizing, fungicide drenching and general housekeeping.

2. Roof Maintenance Safety Procedures

Greenroofs by their very nature are elevated and present a potential for severe falls. Listing all the safety requirements for all roofs would be a book in itself. Let it suffice to say that commercially OSHA has many requirements for safety equipment and procedure for working on any roof including greenroofs. To insure safety regardless of whether the roof is commercial or residential a few general safety requirements are needed.

- Any possible fall must be prevented by either a roof edge railing or barricade.
- If this is not practical the maintenance person should wear a harness and be attached to an anchor point(s) that will prevent him/her from falling off the roof.
- Other safety measures may be necessary depending on the special needs of the roof (ex. - slope, size, soil, plants, etc.) or the job being done.

3. General Roof Housekeeping

There are some maintenance jobs that aren't optional on greenroofs because they affect the plants or the function of the roof. These are described below:

3.1 Drain Cleanout:

All greenroofs have both above ground and below ground drains to accommodate extreme rain events. The above ground drains usually have grills to avoid leaves or elongated items from clogging the interiors of the drain piping. Some roof soil contains composted yard waste as the organic component of the soil and this may have small twigs within it which will float in heavy rain and build up at the drain grill. The worst problem that a roof can have is to have water pooling to excessive depth on it. This can be avoided by cleaning off the drain grills at least once a month during normal maintenance.

3.2 Swamps:

Most greenroofs are placed on flat roof decks. There is normal variability of elevation in a roof which may cause low areas in the roof deck where water can collect. These areas should be leveled before the membrane is applied but isn't always done properly. This problem may lead to areas where water collects and stays for many days. The sedums cannot tolerate being in standing water and the roof membrane may also have problems with standing water. If standing water is seen on a roof several days after a heavy rain or if the plants are all dying in an area it may be due to a swamp. If the roofing membrane can handle this problem the only choice is to plant a more water tolerant plant in that area.

3.3 Loose flashing:

During the maintenance trip the flashings on the roof should be checked and if needed be repaired. Reroofing or repairing a leak is very expensive compared to fixing a loose flashing which can lead to more serious leaking.

3.4 Fall/winter Clean-up (optional)

Once the roof fills in and the plants mature, most varieties will flower abundantly. This provides beautiful colors in the Spring through Fall but leaves unsightly flower stalks. Winter snow will tend to knock these stalks down. For a really good looking roof these stalks can be removed carefully with a string trimmer.

4. Nutrients and Supplements

One of the many uses of a greenroof is to absorb pollutants from the rain that falls on the roof. Although this is proven to work and is a good environmental use

of the plants, it doesn't make sense to deprive the plants of nutrition during the first couple years before the roof is established. During the establishment period the plants need to grow rapidly to fill in the roof area. This slows weed growth, prevents wind and rain erosion of the soil and improves roof appearance.

1. Fertilizers:

Stonecrop plants do not need much fertilizer but as they grow rapidly they need more than the rain can provide. A balanced slow release fertilizer that releases over 3-12 months is best. Osmocote or Nutricote are examples of commercially available slow release fertilizers. Initially a 10-10-10 is good at supporting top growth, root growth and flowering (14-14-14 or similar can also be used). In the second and later years as the plants fill in and growth slows the fertilizer should be changed to more nitrogen (ex. 18-6-12) but still be of a slow release variety.

Besides promoting growth, fertilizers also keep the plant healthy and more resistant to disease. Certainly if the roof is to be viewed the fertilizer keeps the plants looking their best.

2. Biologicals:

Most roof soils are compounded from a light weight aggregate that is heated to very high temperatures (resulting in sterilization) and a compost fraction that may have also been somewhat sterilized. Depending on the soil that comes in with the plants, the overall roof soil may be somewhat deficient in soil biologicals. Recently soil producers and plant growers have been testing various soil biological supplements. These supplements range from compost teas, worm castings and worm casting teas (ex. VermaPlex), biological nutrients (OMRI Nutricast) and mycorrhizal injections (Mycorrhizal Application, Inc.). One source is Southern Organics and Supply (www.southernorganicsandsupply.com). Recent experience seems to show that these supplements all help if the roof soil is sterile and the plants don't bring in soil biologicals. Certainly if the plants aren't growing well and they have been fertilized and fungicide treated then biologicals would be worth a treatment. VermaPlex can be sprayed on and castings and Nutricast can be hand cast. All plants from Carolina Stonecrops, Inc. have been treated with some biologicals and should not need further treatments in the first year.

5. Disease Prevention and Cures

These plants are generally considered robust to most diseases and pests but unfortunately under conditions of **heat stress, high humidity or overwatering** they can be subject to disease.

5.1 Common diseases:

Fortunately for greenroof plants, they seem to be less susceptible to fungus infection than on-the-ground plants. However that is not to say that fungus cannot cause problems. There are two diseases that cause greenroof plant losses:

- **Pythium**, seen as root rot,
- **Rhizoctonia**, usually seen as leaf, crown and stem rot

In the previous section, biologicals such as worm castings and mycorrhizal were added to the soil to help make it healthier but these have only a limited effect on diseases.

As a maintenance person, you aren't required to actually identify the plant disease in order to treat it. Hopefully with a good preventive maintenance program the diseases will not get a foothold on your roof. However, if problems are evident, most local agricultural extension agents can get you a fast disease diagnosis and suggested a remedy. However, we will present preventative sprays that have worked well on rooftops and at the nursery.

5.2 Preventative Treatments:

Fortunately for maintenance crews there are a number of good fungicides available for the main fungus diseases mentioned above. Because most greenroof owners don't want chemical fungicides used on their roof, we would recommend a drench of an OMRI recommended biofungicide, **Rhapsody or CEASE** composed of a dilute solution of a bacteria, *Bacillus subtilis*. This is available from most agricultural chemical suppliers in one gallon containers. Because most of the fungus live in the soil it is important to attack them there using a drench application. The best way to do this is to suck this solution directly into a dosing pump (listed below) with a 100:1 output using a watering wand apply this onto the plants and roof soil.

3. Cure Outbreaks:

Outbreaks of disease usually occur during periods of high temperature (95+ degrees) and high humidity. Long periods of rain or overwatering (irrigating more often than weekly) are a common disease initiator. Disease shows in 2 ways: 1- plants turning to their winter colors or 2- brown spots showing up on leaves or stems. **Plants changing color often is due to root rot by pythium caused by overwatering.** If a plant is changing color in mid season, pull it out and look at the roots. Good roots should be white in color. Pythium causes roots to rot and

turn black. All infected plants should be pulled out and discarded. Then the soil and remaining good plants should be drenched using **Trueban** or **Terrazole**.

Brown spots on leaves, stems or crowns is primarily due to rhizoctonia fungus. Plant stress due to heat and humidity is a primary cause of this problem. During periods of high temperatures (95+ degrees) it is good practice to spray the plants with a backpack sprayer every couple weeks with **Chlorothalonil** (available as **Daconil** or Ortho General garden disease prevention). Outbreaks require spraying and if the outbreak is bad the plants need to be pulled out and removed.

Because both pythium and rhizoctonia infections appear during periods of 95+ degrees temperature recently we have been using a new fungicide mix product called **Banrot** to suppress or cure both. It is very effective and probably needed only once per summer. It is applied as a drench to the soil and is a systemic fungicide for rhizoctonia (meaning it enters the roots and moves up into the stems and leaves of the plants).

4. Safe Application Practices and Dosimeters:

Fungicide application, like application of insecticides and pesticides, should be done safely. This means that at a minimum rubber gloves, respirator and long pants and long sleeved shirts should be worn. Some states or local codes may require that spraying be done by trained/certified personnel. Fortunately, drenching which is most often required does not produce a fine spray that can be inhaled or carried by wind.

Drenching is best done using a 100:1 dosing pump made by Chemilizer or Dosatron. If a lot of drenching is done, a dosing pump (costing \$225-400) is well worth the expenditure because it gives a 100:1 dilution requiring making/carrying smaller volumes of fungicide mix. The dosimeter also supplies a more consistent mix. Regardless of apparatus used the idea is to drench the soil with a dilute fungicide solution through a regular watering wand.

Foliar spraying is used if the fungus is found above ground on leaves or stem. This is best done with a backpack sprayer. Because of the finer spray much more care must be taken to avoid inhalation and wind carry of the spray.

5. Recommended concentrations to be used for Banrot, Truban and Terrazole

100:1 aspirator or dosing pump:

This method is used at the nursery both as a preventative treatment and also if a disease outbreak occurs. 6 oz of wettable powder Banrot is mixed in 2 gallons of water. This mixture after mixing is then diluted and applied using a water wand attached to a 100:1 dosing pump. The 2 gallons of concentrate after dilution will be applied to 200 2'x2' prevegetated modules or 400 nursery trays of plugs or 800 sq ft of greenroof. Likewise if Truban or Terrazole is used the same amount of wettable solid is used in 2 gallons for the same square footage.

6. Pests

In most greenroofs there are few pests to worry about. Most pests are controlled by the relatively hostile environment of the roof. However some pests will be encouraged by over-irrigation.

6.1 Above ground pests

Most pests will be seen during the roof grow-in period. At this time birds can be a minor problem. They often will pull plugs out of the ground to use the plant stems in nests. Usually this is not a problem as the birds spread the plant pieces around the roof where they eventually root as new plants. Most plant plugs can't be pulled out after a month of being planted.

Snails and slugs can be a more serious problem because they are indicators of excess irrigation or excess rain. The snails/slugs are multiplying because of the water and possible death of the plants. The best solution is to decrease irrigation if that is being used and check the plants for signs of fungus. If a lot of rain has been occurring then preventative fungicide drenching is required. The snails and slugs will die out once the irrigation or rains have become normal. In a worst case situation some snail pellets may be needed.

Grasshoppers have been found on-ground stonecrops but normally aren't a problem. If found on roof gardens ignore them unless they start to do noticeable damage to the plants.

6.2 Below ground pests

Mealy bugs, sow bugs and centipedes have been found in greenroof plantings. In the nursery they are handled during fungus spraying with additions of liquid seven. They eat some roots but don't normally have a detrimental effect on the plants. If the plants aren't doing well first check for fungus and then look at the roots of a plant. Mealy bugs show up as white areas, sow bugs and centipedes are easily seen if found. Worst case would require a application of liquid seven but only if flowers aren't present as this kills bees.

7.0 Weeds

Like any garden, weeds are the biggest maintenance requirement. During the establishment of the greenroof weeds require the most work. Roofs due to their elevated position are less susceptible to weed infestation but are not totally immune. Wind and birds can carry weed seeds to the roof. Coarse greenroof soil can minimize weed growth but at the expense of greenroof plant growth. Even after plants are fully covering the roof some weeds have been found growing up through the greenroof plant carpet.

Weeds can not be ignored because most spread by producing extreme numbers of seed. In addition they have enormous root structures that can hold their own against the greenroof plants. Also some weeds can handle the extreme conditions on the greenroof.

7.1 Prevention

Although we want to avoid treating the roof with chemicals one very good way to minimize weeds is to sprinkle the roof with Preen during the first year to avoid weeds getting a foothold.

7.2 Removal

No one likes to weed but it is a must in order to keep the roof from becoming a weed patch. During the first year weeds should be pulled and removed at least every 2 weeks. They are much easier to pull after a rain and before their roots get too deep. Most of the weeds really take off in mid to late summer and many will go to seed after only a few weeks growth. ***Every effort must be made to remove the weeds before they go to seed.***

Most weed varieties are easily seen as plants that are different from the stonecrop plants. However one plant that does very well with the stonecrops and is very hard to see in a greenroof is prostrate spurge It is low and green/grey and is very well camouflaged with the soil.

8. Irrigation

More greenroof plants are killed by irrigation than any other cause. This is done by either ignoring irrigation during periods of extreme drought or more frequently by overwatering. Stonecrops are naturally drought tolerant plants but they are not cactus. They need some periodic water to make them grow, especially during the first year when they are establishing a large root system and growing in size.

8.1 Difference from other plants

The stonecrops differ from other plants in their photosynthesis process. Under conditions of sufficient water, they run photosynthesis in one step. They absorb carbon dioxide, water and sunlight and give off oxygen during daylight hours. However, during periods of water deficiency, they shift photosynthesis process into 2 steps: 1- reaction of carbon dioxide with water and sunlight during the day and expulsion of oxygen and uptake of carbon dioxide during the night. By doing this, the stoma (breathing holes) are only open during the cooler nights thus conserving water. The key point here is that this capability still requires water but not as much as a normal plant.

Another difference is that stonecrops actually need their roots to be dry part of the time. They cannot tolerate having roots immersed in water for days at a time.

8.2 Recommended Irrigation

Proper irrigation depends on soil depth, humidity, age of the plants and temperature. For 4 inch deep soil, watering is needed only once a week for newly planted plugs and once every 2-3 weeks for an established roof. More frequent watering will make the plants grow slightly faster but will also make them more susceptible to fungus infection.

During a drought it is critical that newly planted plugs have water at least every 2 weeks. Established plants can get by with water every month as a minimum.

We can't stress too much--- ***OVERWATERING KILLS PLANTS!***

9. Plant Fill-in and Replacement

As the roof grows in there will most likely be some areas where the plants die out or just don't fill in fast enough. In these areas try to define and correct problems such as "swamps" or dense shade. If there are no obvious problems and the areas are small these areas can be improved by taking cuttings off bigger plants and partially burying the cuttings in the soil. The cuttings can be tossed on the soil but the yield of new plants won't be as good.

If a larger area needs help the best way will be to purchase assorted plugs and plant them to fill in. ***Remember if you don't try to cover an open area, nature will do so with weeds.***

10. Green Walls

Many of the areas about greenroofs apply to greenwalls. There are some differences that are worth noting.

1. **Irrigation**- Greenwalls are always irrigated because they cannot depend on rain. **Overwatering of greenwalls is a big problem.** It often leads to fungus infection which is hard to handle unless a drench dosing pump is built into the irrigation system.
2. **Shade**- Most stonecrops require moderately full sun. Due to the vertical nature of the walls, shade is a major problem on walls that face northeast, north and northwest. These shaded walls require a shade loving sedum like *Sedum ternatum*. If other species are used they will usually become leggy and most will die out over time.
3. **Maintenance**- Most greenwalls are extremely hard to get up to for maintenance and thus usually aren't maintained. As a result it is even more critical that irrigation is tightly controlled and that a dosing pump be incorporated into the irrigation for fungicide treatment and fertilization.

11. Summary

Year 1-

Weed every 2 weeks.

Slow-release fertilize and fill in plants every 3 months

Visually inspect plants and roof every 2 months

Irrigate weekly except if rain occurs

Year 2-

Weed every month and use Preen early in Spring to stop weed germination.

Slow-release fertilize and fill in plants once a year

Visually inspect plants and roof every 2 months

Irrigate every third week if no rain

Note as discussed in the book this schedule should help to keep the plants and greenroof functioning well, looking good and requiring low level of maintenance..