Extension Leaflet

Soil solarization for control of soil-borne pathogens in home gardens

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INTRODUCTION

Effective control of plant parasitic nematodes, soil-borne plant pathogens and some weed pests is a serious challenge for farmers and home gardeners in Yap. Resistant varieties, crop rotation, and pesticides are not always viable control options for these destructive pests. Current interests in organic farming methods highlight the need for alternative methods of controlling the damaging nematodes, soil-borne fungi, and bacteria affecting crops in home gardens.

Soil solarization is a non-chemical method of controlling soil-borne pests by placing plastic sheets on moist soil during periods of high ambient temperature. The plastic sheets allow the sun's radiant energy to be trapped in the soil, heating the upper levels. Solarization during the hot summer months can increase soil temperature to levels that kill many disease-causing organisms and nematodes. In addition, this procedure gives good weed control in home gardens where use of herbicides is unwarranted. It leaves no toxic residues and can be easily used on a small or large scale. Soil solarization also improves soil structure and increases the bioavailability of nitrogen and other essential plant nutrients by breaking down soluble organic matter.

Solarization is a simple, safe, and effective method that has been in practice in several countries for effective control of soil pathogens. It can be combined with organic soil amendments for greater efficiency. Improved crop growth and yield performance often occur in solarized soil and may continue for more than one growing season.

HOW TO SOLARIZE SOIL

The area to be solarized should be leveled and free of weeds, debris, or large clods. Transparent plastic tarps or sheeting of about 1 - 6 mil thick are anchored to the soil by burying the edges in a trench around the treated area. To prevent air pockets that retard the soil heating process, there should be a minimum of space between tarps and the soil surface. The soil under the plastic is then soaked with water by inserting one or more hoses. If this method of soaking is impractical, the soil may be irrigated before laying the plastic, but care should be taken to apply the plastic as soon as possible to avoid water loss. The plastic should be left in place from 8 to 12 weeks to allow the soil to heat to the greatest depth possible. It should then be removed and the soil allowed to dry to a workable texture before planting seeds or seedlings.

Time of year: Highest soil temperatures are obtained when the day lengths are long, air temperatures are high, the sky is clear, and there is no wind. The peak temperature in many areas of Yap is around April 15. Therefore, the best time for solarization of soil in Yap is between March and May.

Plastic color: Clear or transparent polyethylene plastic should be used, not black plastic. Transparent plastic results in greater transmission of solar energy to the soil which allows the soil to heat to higher temperatures.

Solarized experimental plot

Plastic thickness: Polyethylene plastic of 1 mil thick is the most efficient and economical for soil heating. However, it is easier to rip or puncture and is less able to withstand high winds. If holes or tears occur in the plastic, they should be patched with clear patching tape or duct tape. Thick transparent plastic (4 - 6 mils) reflects more solar energy than thinner plastic (1 - 2 mil) and results in slightly lower temperatures.

Preparation of soil: It is important that the area to be treated is relatively smooth and free of weeds, plants, debris, and large clods (lump of soil) which would raise the plastic off the ground. Maximum soil heating occurs when the plastic is close to the soil, therefore air pockets caused by large clods or deep furrows should be avoided. The soil should be disked, tilled or turned over by hand and raked smooth to provide an even surface and to help water penetrate and moisten the soil profile.

Soil moisture: Soil must be moist for maximum effect as moisture not only makes organisms more sensitive to heat, but it also conducts heat faster and deeper into the soil. Soil can be moistened by pre-irrigation or by drip or furrow irrigation after laying the plastic sheet.

Duration of soil coverage: Killing of pathogens and pests is related to time and temperature exposure. The longer the soil is heated, the better the control. In addition, longer soil coverage increases the opportunity for biological control mechanisms to work. Although some pests are killed within days, 4 to 8 weeks of treatment in full sun during the summer is usually best.

Benefits of soil solarization

Disease control: Soil Solarization provides excellent control of many disease causing soil pathogens. Pathogens usually re-infest solarized soil at slower rates than non-treated soil.

Weed control: Seed and seedlings of many grass and other weeds can be controlled with soil solarization.

Nematode control: Soil solarization reduces nematode populations in considerable numbers. Our field experiments revealed significant reduction in root-knot nematode population in soil depths up to 8 inches. Solarization is, therefore, useful and economically feasible for shallow-rooted crops and home gardens.

Increased plant growth response: Plants often grow faster and produce higher yields when grown in solarized compared to non-treated soil. This phenomenon is attributed to a combination of several factors such as pathogen and weed control, better nutrient availability , and action of beneficial microorganisms.

Conclusions

Soil solarization can control many soil-borne pathogens and pests. The method is simple, safe, and effective, leaves no toxic residues, and can be easily used on a small or large scale. Significant increase in plant growth, harvestable yield, and crop quality often occur in solarized soil. The potential for using soil solarization to control soil borne diseases and pests in Yap Island is excellent.

This publication is a brief introduction to soil solarization. For further information, contact Agricultural Experiment Station.

Suggested readings

Katan, J., and J. E. DeVay, eds. 1991. Soil solarization. CRC Press, Boca Raton, Ann Arbor, Boston, London.

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Lindsay, C. 2003. Soil Solarization for control of soil-borne pathogens and weeds. Home and Garden Information Center, Clemson University; HGIC# 1261.

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