BEST4 SOIL

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(BIO)SOLARISATION: PRACTICAL INFORMATION

This factsheet contains complementary information to the Best4Soil video on (Bio)Solarisation: Practical information.

INTRODUCTION

Solarisation is a soil disinfection method consisting of covering a moistened soil with a thin transparent plastic film, for 4-6 weeks during the part of the year with the highest sun radiation and temperatures. Solarisation increases soil temperature and produces changes in the microbial soil community as well as the chemical and physical properties of the soil. It is a method commonly used in the greenhouses of Southern European countries in summer, with the aim of 'enhancing' the health of the soil for the next crop, at the same time reducing the level of harmful soilborne pests.

WHEN SHOULD A SOIL BE SOLARISED?

Solarisation is applied when the presence of pests in the soil can potentially limit the profitability of the subsequent crop. These pests include fungi, nematodes, bacteria, insects and weeds. Moreover, mono-cropping practice can lead a soil to become fatigued, so solarisation can help to re-establish the health of the soil, and recover the fertility of the soil. The cost of this technique is comparatively high, so economically it is usually only appropriate for intensive crop systems.

STEPS TOWARDS A GOOD SOLARISATION

The efficacy of soil solarisation is determined by local conditions, but in general steps to achieve a good solarisation, as explained in the Best4Soil video (LINK to videos 14 and 15, solarisation) are consistent to all locations. The longer the solarisation is in place, the better the expected results. It is recommended to leave soil solarising for **at least 4 weeks, however 6 weeks are better**. The preferred period for carrying out a solarisation ranges between 15th June and 1st September at Mediterranean latitudes.

Sufficient moistening of the soil is required. Irrigating the soil close to water saturation before and/or after the film deployment will assure good heat transmission to all the parts of the soil. Soil water saturation can be assured with tensiometers measuring between 0-10 cb (fig. 1). Additionally, tensiometers at different depths can help to avoid uneven moisture throughout the soil and leaching of nutrients (fig. 2).

Fig. 1: Tensiometers to measure the soil humidity during solarisation. The left one is placed at 15 cm-depth, and the right one at 35 cm-depth.

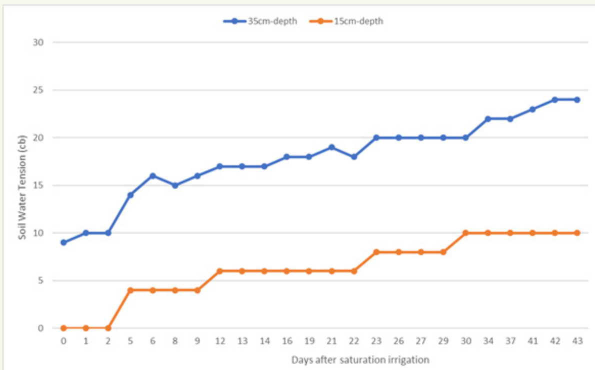

Fig. 2: Evolution of soil water tension at two depths during solarisation.

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A **transparent film** is used to allow the sun radiation to penetrate into the soil, heating the water in the saturated soil. Polyethylene is the most common material used for the films, with a thicknesses between 0.25-0.325 microns recommended. Some films for solarisation include layers with specific products to increase the impermeability or to reduce condensation, thus improving the efficacy of the solarisation treatment.

A high air tightness is required to avoid losses of heated air from the soil. To achieve this, the edges of the films are covered with soil once they are deployed (fig. 3). If possible, the films can be overlapped but firmly joined. The use of staples after rolling two films is a good and simple technique to do it (fig. 4). In greenhouses with posts, sealer tape can help to fix the film edge to the post.

Fig. 3: After deploying the film, edges are covered with soil or other material, to avoid losses of heated air.

Fig. 4: Sealing of film layers can be carried on by stapling.

Shades in greenhouses reduce the light interception by the soil, so they have to be rolled back or removed. Also, if white paint was added to shade the greenhouse, it has to be washed off before solarisation.

The majority of soilborne pathogens are thermally inactivated when exposed for 30 minutes to temperatures ranging between 45-55 °C (table 1). These temperatures are easily reached at 15 cm-depth in well solarised soils.

TABLE 1: THERMAL INACTIVATION OF SEVERAL SOILBORNE PATHOGENS.

Adapted from Jarvis R. J. (1997). Managing Diseases in Greenhouse Crops, APS press, USA.

Pathogen	Temperature (°C)	Exposition time (min)
Botrytis cinerea	55	15
Cylindrocarpon destructans	*50*	30
Fusarium oxysporum	*57*	30
Phialophora cinerescens	*50*	30
Phytophthora cryptogea	*50*	30
Pythium sp.	*53*	30
Rhizoctonia solani	*53*	30
Sclerotinia sclerotiurum	*50*	5
Verticillium dahliae	*58*	30
Heterodera marioni	*48*	15
Meloidogyne incognita	*48*	10
Pratylenchus penetrans	*49*	10

The addition of fresh organic matter into the soil before solarisation is called biosolarisation. This practice can increase the efficacy of solarisation as the incorporation of organic matter improves the health of the soil and the amount and diversity of non-pathogenic microorganisms in the soil. The incorporation of the organic matter (C/N ratio of 8 – 20) in combination with the excess water supplied starts a fast decomposition that produces biocidal/biostatic products (ammonium, polyphenolics, fatty acids,…) for 2-3 days. At the same time aerobic microorganisms that consume available oxygen are highly stimulated and this induces the soil microbial community to shift to facultative and obligate anaerobes. As the soil is covered and there is abundant water, oxygen cannot be supplied, so there are three factors, added to the high temperature, affecting plant pathogens in this first stage: (1) the lack of oxygen, (2) the abundance of competitors and (3) the presence of toxic compounds. Once these immediate effects dissipate, there is a longer second stage in which the microbial population decreases, but the balance between saprophytic and pathogenic microorganisms moves in favour of saprophytic. As time

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goes by the soil moisture level decreases and the oxygen content increases. Other biocidal molecules are released once the moisture levels decrease. After this, saprophytic microorganism populations increase and establish as there is organic matter available. Additionally, a soil colonization by the surrounding environmental microbiota is possible. Niche and resource limitations for soil microbiology appear; competition and fungistasis* phenomenons are observed.

* Fungistasis: restriction of fungal propagules to a certain extent in their ability to grow or germinate.

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