The Possabilty of Using Soil Solarization to Control Some of The Soil Borne Pathogens Under El- Taif Area, KSA Conditions

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Abstract

Soil solarization (ss) has been widely utilized in arid, cloud free climates where in many countries such as Egypt, India, Jordan, and Syria. This work was carried out at the labs of Eltaif Faculty of Teachers greenhouses during two successive summer seasons of 2001 and 2002. 100 soil samples were collected from randomly selected farms located in El-Shafa valley, El-Taif, KSA. Solarization with clear plastic mulch for 3 periods of one month each between July and September were conducted in addition to the control treatments (no ss or irrigation & no ss but irrigation). Each ss period had 20 pots that were filled with soil, will irrigated and covered with the clear plastic films, In addition to 20 pots of each of the control treatments.

Culturing the soil solution on the PDA medium produced 23 fungal genera of which *Fusarium, Rhizoctonia, Pythium, Alternaria, Botrytis, Penicillium* and *Aspergillus* were the most prevalent fungal genera. The first and second periods (July and August) had a significant effect on reducing the number of the soil borne fungi no matter the type of this fungus. From the obtained results we can conclude that using the soil solarization to control, partially, some of the soil borne pathogens can be used under the conditions of El-Taif area.

Introduction

Soil solarization is a method of heating soil by covering it with transparent polythene sheeting during hot periods to control soilborne diseases Chellemi *et al.,* (1993). The technique has been commercially exploited for growing high-value crops in diseased soils in environments with a hot summer (maximum daily air temperatures regularly exceeding 35°C). The primary advantage of soil solarization is that it is a nonchemical method of soil disinfestation so worker and environmental exposure to chemicals are reduced. It can be readily integrated into the existing system of vegetable plasticulture and utilize existing equipment. It may reduce the cost of soilborne pest management by eliminating or reducing the amount of pesticide used. In locations with no known major pathogens, soil solarization often results in improved plant growth, a phenomenon called increased growth response. It is not related to improved root growth but may be partially due to delayed leaf senescence (Gruenzweig *et al.,* 1993).

Soil solarization has been widely utilized in arid, cloud free climates where irrigation is available, in countries such as Egypt, India, Jordan, and Syria. In the U.S., and conditions in California and Texas have been amenable to utilizing solarization for soilborne pest control. The more temperate the climate, the shorter the period during which solarization can be conducted. Only the warmest months of the year are useful for solarization (Chase *et al.,* 1997).

Certain soil borne plant pathogens can be controlled with some success through a process of solar heating. Two important factors affecting the efficacy of soil solarization are the soil temperature. and the duration of exposure. Pullman *et al.,* (1981) showed that four pathogenic fungi were controlled at constant temperatures ranging from 37 to 50 %C (99 to 122 %F). The time required for pathogen mortality decreased as temperature increased. *Rhizoctonia solani,* for example, was killed in 10 min at 50 %C but required 14 days at 39 %C (102 %F). Overman (1985) found that soil solarization was most effective at reducing total number of nematodes and incidence of *Verticillium* wilt than native weed cover, herbicide fallow, or sorghum/sudangrass cover crop. In a more st'dy of soil solarization as an alternative to methyl bromide for tomato production, season-long suppression of stubby root, ring and reniform nematodes was reported (Chellemi *et al.,* 1993).

Gamliel and Stapleton (1997) have suggested the incorporation of organic amendments as a nonchemical approach to improving the efficacy and predictability of pathogen control by soil solarization. They have attributed the improved

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control to enhanced production of volatile substances from the amendments. Evidence for organic amendments such as cabbage residue has been conflicting. Recently Coelho *et al.*, (1999) reported that incorporation of cabbage residue did not enhance the control of two species of *Phytophthora* by soil solarization.

In Taif, KSA, air temperatures are adequate for effective soil solarization from late spring and through summer (Fig 1). The average maximum temperature is around 35-39 C° during the months of July to September. Al Shafa area is a small village situated high upon the Sarawat mountains, rich in agricultural products. The fruit and vegetable gardens of Taif are located there.

This study aims to investigate the possibility of using soil solarization under the Shafa valley conditions in order to partially control some of the soilborne pathogens.

Materials and Methods

This work was carried out at the labs of El-Taif Faculty of Teachers greenhouses during two successive summer seasons of 2001 and 2002. One hundred soil samples were collected from randomly selected farms located in El-Shafa valley, El-Taif, KSA. The soil samples were consisting of 20 cores taken at random locations throughout five fields. The samples were taken to a depth of 10 cm and were about 2.5 kg, each. The soil of the samples fields was almost clay to clay loam. The 100 samples were mixed will and were distributed in 25 cm plastic pots equally.

Solarization with clear plastic mulch for 3 periods of one month each between July and September were conducted in addition to the control treatments (no ss or irrigation & no ss but irrigation). Each ss period had 20 pots that were filled with soil, will irrigated and covered with the clear plastic films, In addition to 20 pots of each of the control treatments. The polyethylene film was with a sickness of 30 μm. Then the pots were moved to the greenhouse. Soil samples were collected from the pots before and after the ss treatment. The experiment was conducted in a randomized block design with 20 replicates.

Count of soil borne fungi:

Ten grams of soil were taken from the top 10 cm of the pots right before covering the pots with plastic films and at the end of the month. The ten grams with 90 ml distilled water were shacked in bottles for 10 mints and allowed to settle for 2 minutes and used as stock solution 1/1000.

Ten ml of the desired dilution was transferred to sterile petri dishes, which has 15 ml PDA medium. The medium also has Rose Bengal at the rate of 10ml/L to prevent bacterial growth. Te dishes were rotated by hand in a broad swirling motion, so that the dilution soil extract can be dispersed over the agar film. The culture was incubated at 28 C° for 5-7 days and the obtained colonies were counted and recorded. All data were statically analyzed.

Results and Discussion

Culturing the soil solution on the PDA medium produced 23 fungi genera. The most prevalent genera were: *Fusarium*, *Rhizoctonia*, *Pythium*, Alternaria, *Potrytis*, *Penicillium* and *Aspergillus*. Figures (2-8) presents the effect of ss treatments on the total counts of the seven soil borne fungi. The control treatments in all the studied periods and over the two seasons, more or lees, were not effected by the sun exposure.

The first and second periods (July and August) had a significant effect on reducing the number of the soil borne fungi no matter the type of this fungus. However, in the first summer season (2001) the July treatment did not reduce the number of the fungi at the level of the August treatment. This was due to the moderate temperatures that were occurred during this period (Fig. 1). Moreover the July treatment on the second season (2002) recorded the highest reduction on the number of the fungi in general. This may be due to the high temperature that was occurred during this period of treatment. These results were in agreement with several investigators. Stapleton and DeVay, (1986) indicated that mulching with clear polyethylene film during the hottest months of the year to achieve soil disinfestations is known as soil solarization. Soil solarization utilizes the sun's energy to heat moist soil. Transparent polyethylene film allows the solar radiation to be transmitted directly to the soil and also reduces moisture loss from the soil through evaporation. Higher soil temperatures may be obtained with dark-colored soils since they absorb more solar radiation than light-colored soils. Abd El-Megid *et al.*, (1997) found that seed-bed solarization significantly reduced smut pathogen and improved seedling stand and characters. Smut disease was completely controlled by soil solarization in both seasons. Same results were reported by Chellemi *et al.*, 1993, Gamliel and Stapleton (1997) and Coelho *et al.*, (1999).

From the obtained results we can conclude that using the soil solarization to control, partially, some of the soil borne pathogens can be used under the conditions of El-Taif area. Soil solarization is a simple, safe, and effective alternative to the toxic, costly soil pesticides and the lengthy crop rotations now needed to control many damaging soil pests. In addition, this procedure may give good weed control in situations, particularly home and commercial vegetable production, where effective herbicides are unavailable.

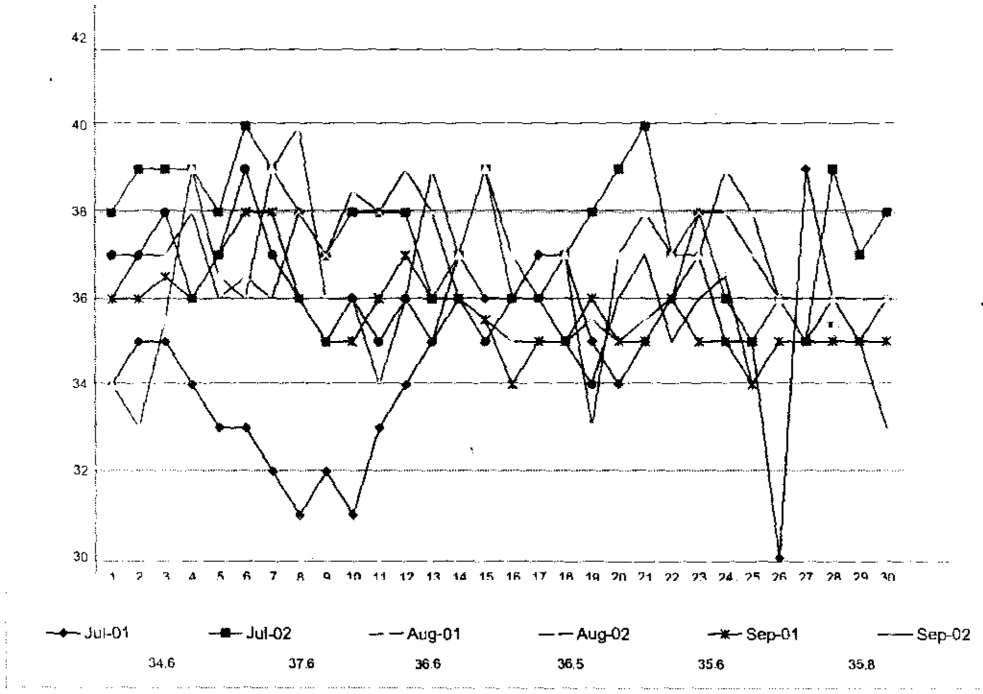

Fig. (1):Average average maximum temperature of Taif, KSA. During July- September, 2001 and 220022

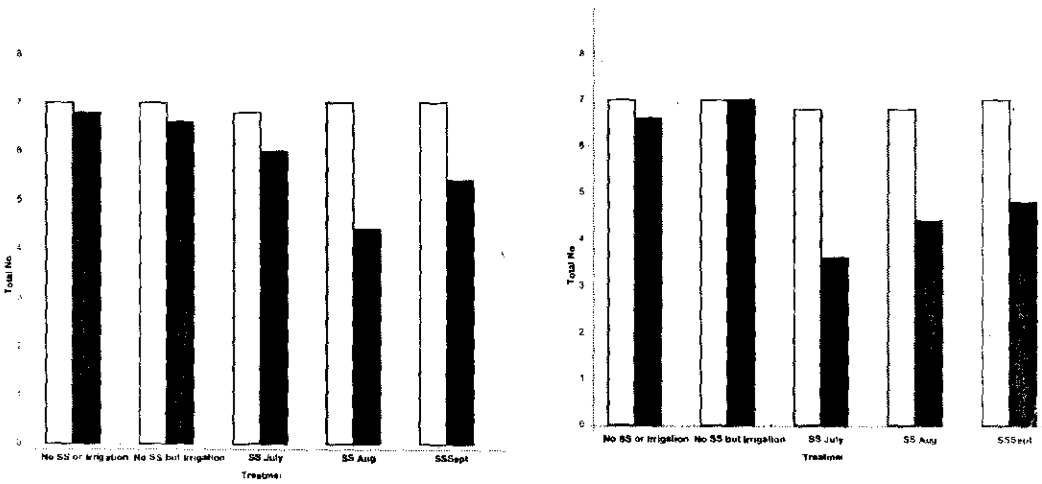

Fig. 2: Effect of SS on total no. / mg dry soil of Alternaria spp in 2001 and 2002 summer seasons.

Befora SS After SS

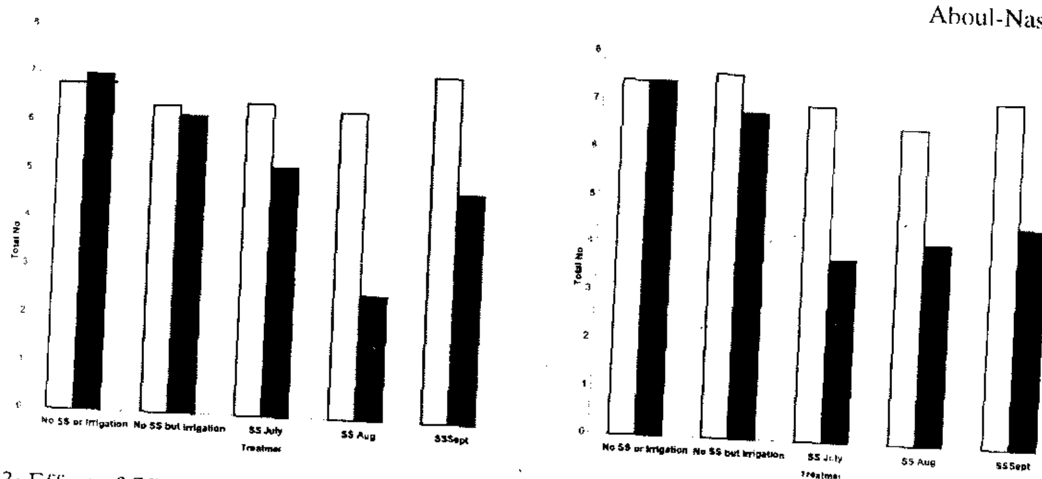

Fig. 3: Effect of SS on total no. / mg dry soil of Aspregillus spp. in 2001 and 2002 summer seasons.

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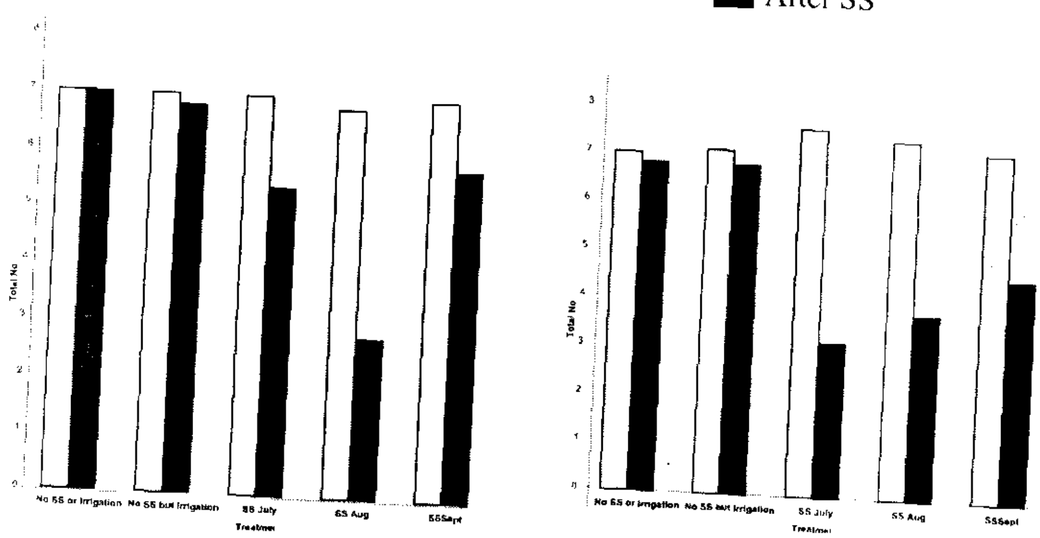

Fig. 4: Effect of SS on total no. / mg dry soil of *Fusarium* spp in 2001 and 2002 summer seasons.

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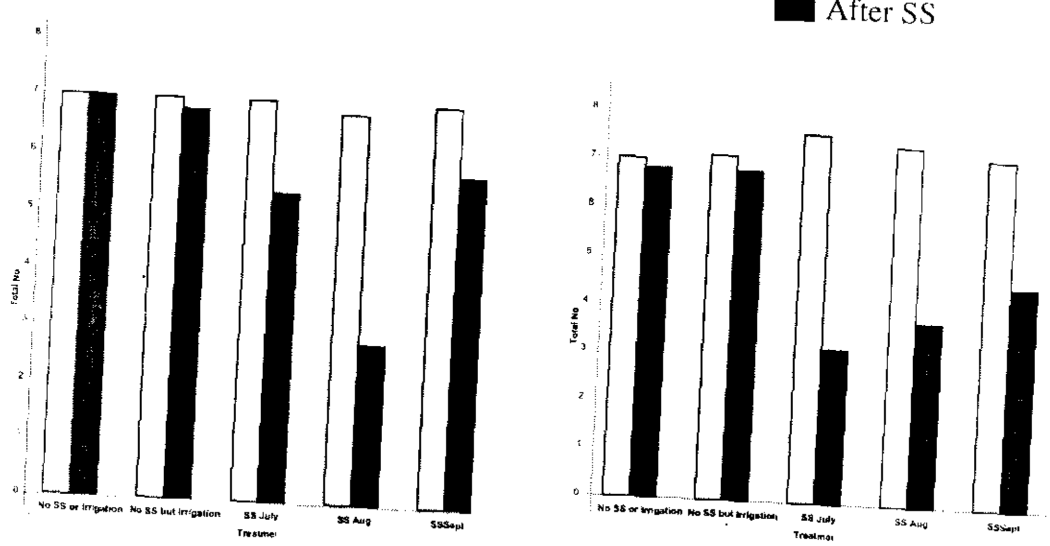

Fig. 5: Effect of SS on total no. / mg dry soil of Penicillium spp. in 2001 and 2002 summer seasons.

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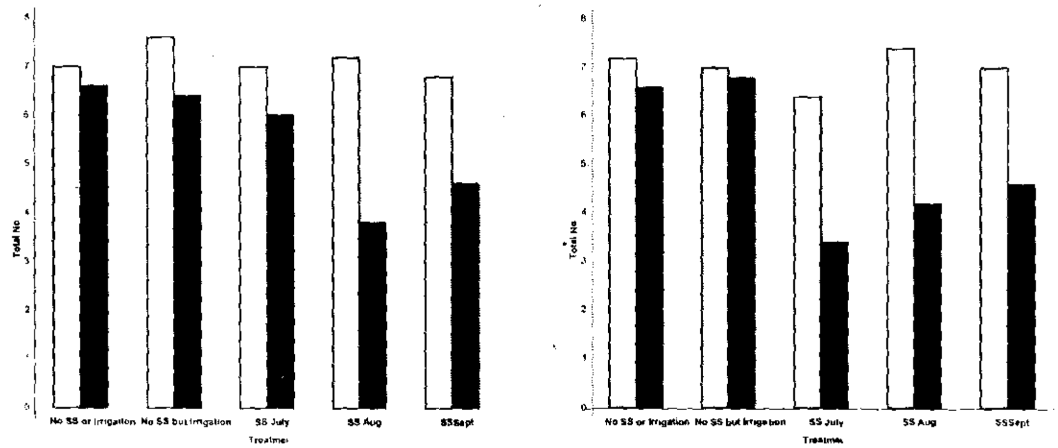

Fig. 6: Effect of SS on total no. / mg dry soil of Phythium spp. in 2001 and 2002 summer seasons.

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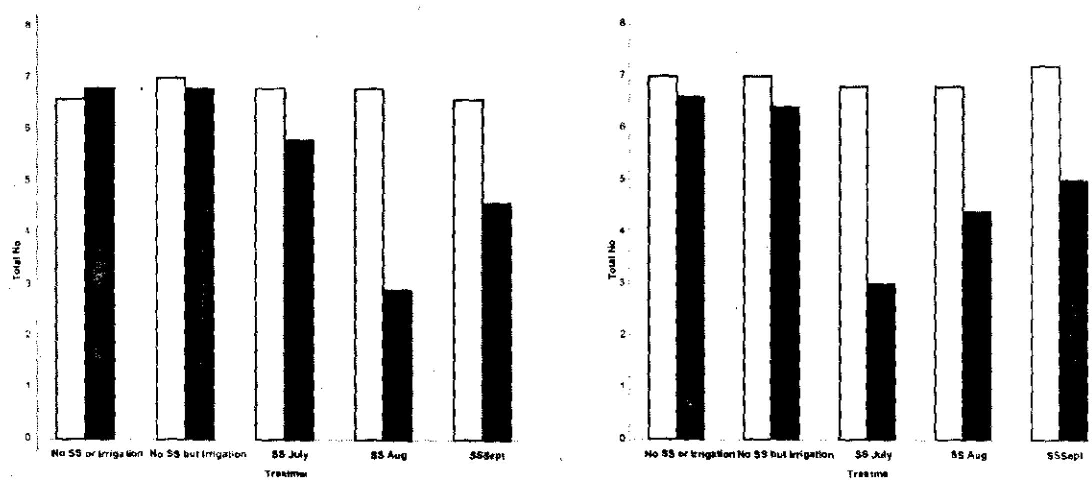

Fig. (7): Effect of SS on total no. / mg dry soil of *Potrytis* spp. in 2001 and 2002 summer seasons.

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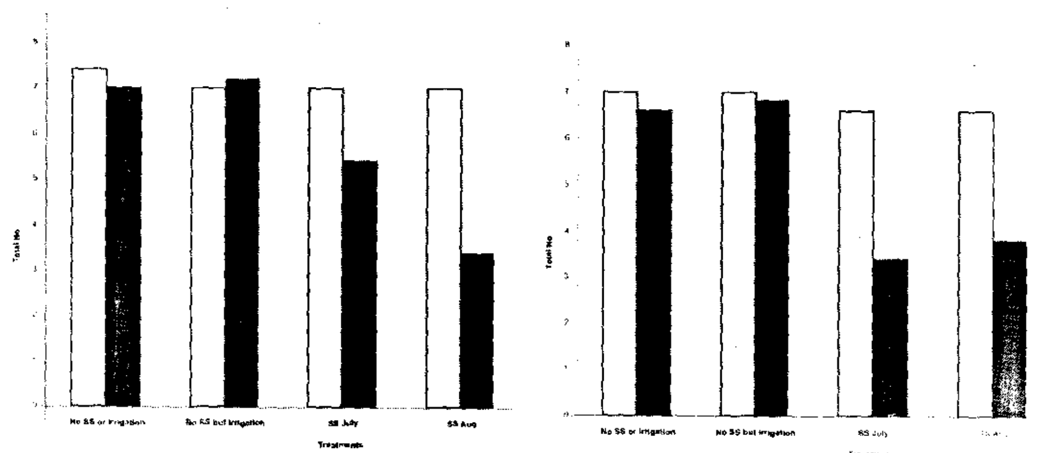

Fig. (8): Effect of SS on total no. / mg dry soil of *Rhizoctonia* spp. in 2001 and [illegible]

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