Effect of Soil Solarization on *Sclerotium cepivourm* Under El- Taif Area, KSA Conditions

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Abstract

White rot, a fungal disease caused by *Sclerotium cepivorum* Berk., is the predominant disease of onion crops worldwide. This work was carried out at the labs of Eltaif Faculty of Teachers greenhouses during two successive summer seasons of 2001 and 2002. The effect of soil solarization (S.S.) on S. *cepivorum* was invistegated. Soil solarization almost reduced the number of Scolerotium to reach 50% of the control treatment after one month of the S.S. However the total number of Scolerotium reached 25% of the control treatment at the end of the three months of S.S.

Introduction

Onion (*Allium cepa* L.) is the world's third most economically important vegetable crop after potatoes and tomatoes. *Allium* white rot (AWR), a fungal disease caused by *Sclerotium cepivorum* Berk., is the predominant disease of onion crops worldwide. Growers, researchers scramble to replace methyl bromideas a soil fumigator. Probably the most serious issue that is facing onion or garlic industry in the Arab region today, other than competition from off-shore sources, is white rot. Tough as it is, some practices and products are being developed to better manage this soilborne disease, also known as *Sclerotium* cepivorum. The growers like garlic and onions because they are great rotational, cash crops. White rot infection can range from no more than a few plants to an area the size of a residential garage in a field. The larger infection sites can be traced back to contamination by seed, equipment, or soil movement. (Robert, 2000). Soil solarization (S.S.) is a relatively new method for controlling soilborne pathogens. It is achieved manually by mulching tilled and irrigated soil with continuous transparent polyethylene sheeting. The soil is heated by solar radiation. Solarization starts usually from Mid-June to Mid-August, for 3-6 weeks, for seed-bed nurseries and productive crops, respectively. Several field experiments and demonstration plots at farmers fields have shown satisfactory results for controlling several soil-borne pathogenic fungi (> 90%) including: *Sclerotium cepivorum* on onion, *Rhizochtonia solani* on cucumber & strawberry, *Fusarium* spp. on tomato, Pythium spp. on pepper, tomato, Phytophthera spp. on tomato, *Pyrenochaeta* spp. on onion & tomato, *Verticillium* spp. on tomato and *Urocystis cepulae* on onion (Sultan et al., 1997). Melero et al. (2000) stated that soil solarization provided the best control of garlic white rot, bringing soil populations of S. *cepivorum* to negligible levels, similar levels of disease control and garlic yields were achieved when tebuconazole was sprayed to stem bases of plants grown from cloves also treated with tebuconazole. McLean et al. (2001) indicated that several alternative strategies for *Allium* white rot control are now being utilized as part of an integrated control programme. These include cultural practices such as 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 oC 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. Recently, a new variety of onion that has been breed to meet the conditions of KSA nemly Oniza cultivar, will be widely sawn to provide the market with its needs. White rot is a very serious diseases. Tell now it is not a major problem in El-Taif area, but it can be if precautions is not taken. This study aims to investigate the possibility of using soil solarization under the Shafa valley conditions in order to control the white rot on onion caused by *Sclerotium cepivorum* pathogen.

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. 100

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 soil and the pots, which used in this experiment, were sterilized using sodium hypocloraite (25 % of the commercial bleach Clorox). After the total dryness of the soil, it was washed twice with sterilized water to remove the residual of the sodium hypocloraite.

Sclerotia of *S. cepivorum* were produced on whole-wheat grains using the technique described by Alexander & Stewart (1994). Sclerotia, 200-500 mm in diameter, were recovered from the wheat grains by aggressive wet sieving (Kay & Stewart 1994), air dried for 24 h then stored in an air-tight container at 4°C. Sclerotia were surface sterilised (1 min wash in 0.5% NaOCl followed by three washes in sterile distilled water) and placed onto sterilised 9 mm circles of seed germination paper (Anchor Paper Limited, Minnesota, USA) on top of potato dextrose agar (PDA) plates amended with 0.02% diallyl disulphide (DADS; Elliott Chemicals Limited, Auckland), a specific germination stimulant. Plates were sealed with polythene wrap and incubated in an airtight container at room temperature for 5 days.

Inocula (sclerotia) *Sclerotium cepivorum* then were mixed with the sterilized soil at the rate of 20 mg inoculum per pot. The pots were irrigated before polyethylene mulching. The polyethylene film was with a sickness of 150 µm. Then the pots were moved to the greenhouse. Solarization was continued for three months (July to September).

Seeds of Oniza onion cultivar (a locaol breed onion that was produced by crossing Giza 6 cv. X Tx blue grano) were used in this study. After the three months of S.S. the polyethylene mulch was removed and seeds were sown at the beginning of October in the seasons of 2001 and 2002. The rate of the seeds per pot was 5 seeds per pot. Ten replicates were used in this study. Each replicate included 10 pots. In addition to the treated S.S. pots 10 pots of no S.S. or irrigation and 10 pots that has no S.S. but irrigated and exposed for the same period were also sown and used as control treatments. All the normal culture practices were followed.

Soil samples were collected from the pots before and after the S.S. treatment at one-month intervals. Also more samples were taken every month after seed cultivation. The methods for quantitative isolation of Scolerotium cepivourm from soil were done according to the methods of Utkhede and Rahe (1978) and Crowe et al. (1980). The following equation according to Hunger et al. (2002) was used to determine an infection score for each replicate:

Infection score = (TL / TR) x 100) / NS

Where: TL = Total lesion length of inoculated seedlings in replicate (mm)

TR = Total root length of inoculated seedlings in replicate (mm)

NS = Number of inoculated seedlings in replicate

The experiment was conducted in a randomized block design with 20 replicates.

Results and Discussion

Effect of S.S. on the number of Scolerotium per pot in the two seasons of this study was very clear and effective (fig. 2 & 3). Soil solarization almost reduced the number of Scolerotium to reach 50% of the control treatment after one month of the S.S. However the total number of Scolerotium reached 25% of the control treatment at the end of the three months of S.S. These findings are in agreements to the findings of Stapleton and DeVay, (1986) who 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 Gamliel and Stapleton (1997) and McLean et al. (2001) who indicated that S.S. provided the best control of white rot in comparison to other methods of the pathogen.

The number of dead plants per pot and the number of the survived onion plats per pot in the two seasons of this study are revealed in fig 4 and 5.The number of the dead or survived plants were affected by S.S. The S.S. treatment gave higher health and less dead plants as compared to control treatments, which did not receive any S.S. treatment. From the obtained results we can conclude that using the soil solarization to control, partially, the white rot pathogen in onion production under the conditions of El-Taif area. It will be a long, expensive process to find a system to manage white rot. We may never find one, since white rot has survived for decades. However S.S. can be a safe alternative until this dream comes true.

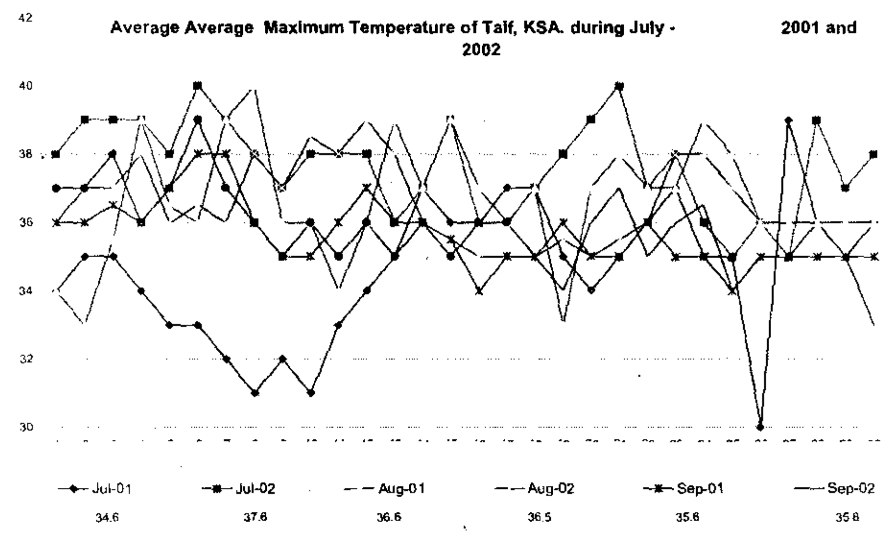

Fig. (1):Average Average Maximum Temperature of Taif, KSA. During July - September, 2001 and 2002.

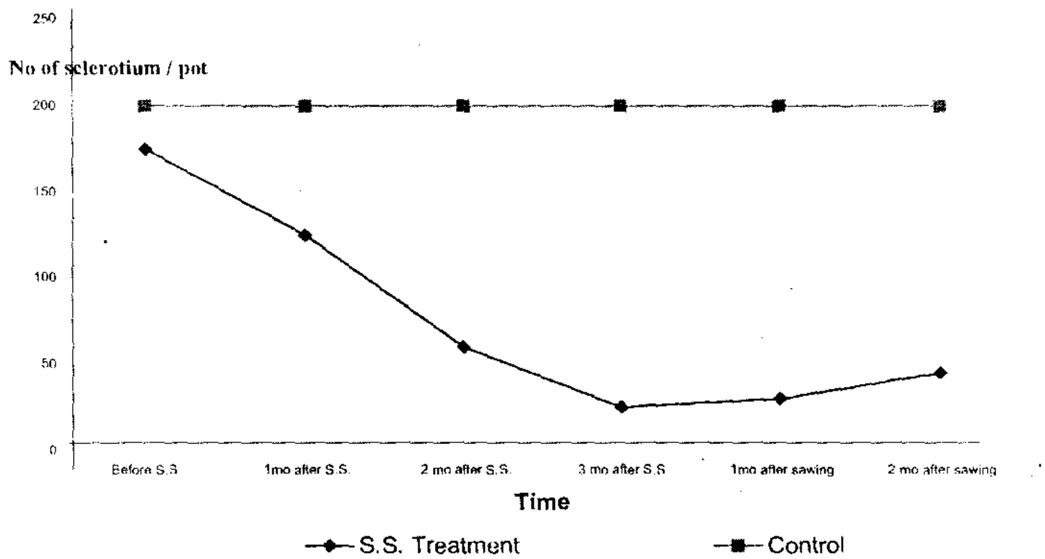

Fig. (2): Effect of S.S on number of *Sclerotium* per pot in 2001 season.

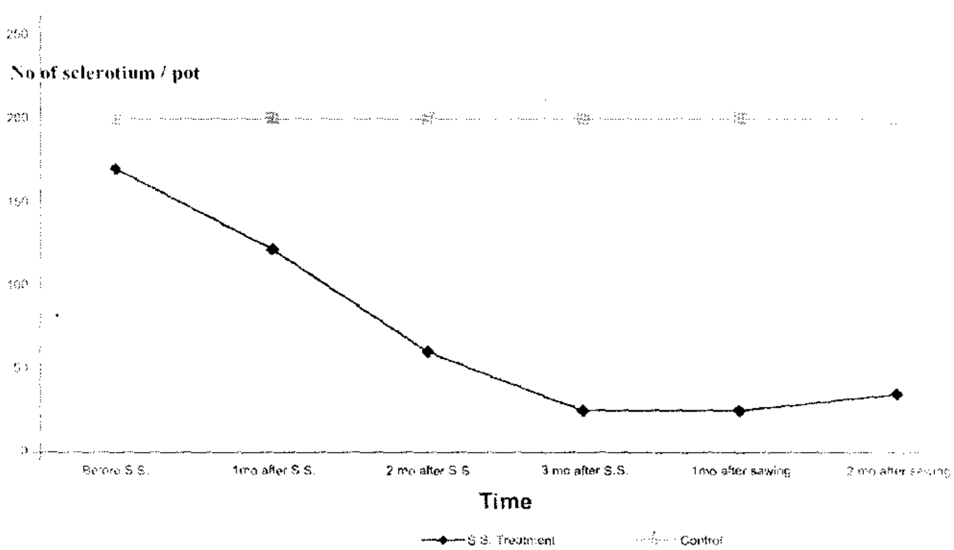

Fig. (3): Effect of S.S on number of *Sclerotium* per pot in 2002 season

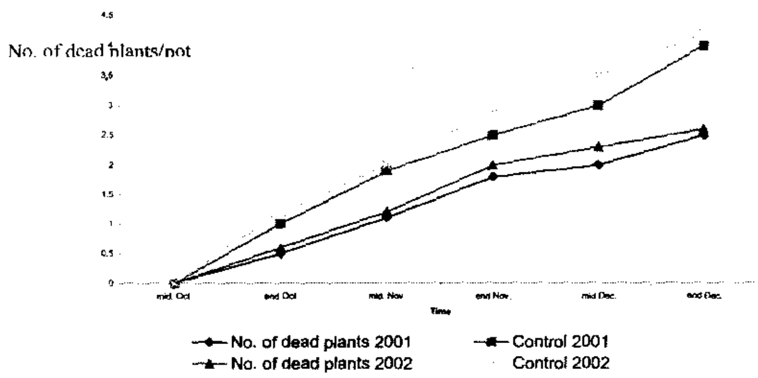

Fig. (4): Effect of S.S on number of dead onion per pot in 2001 and 2002 seasons.

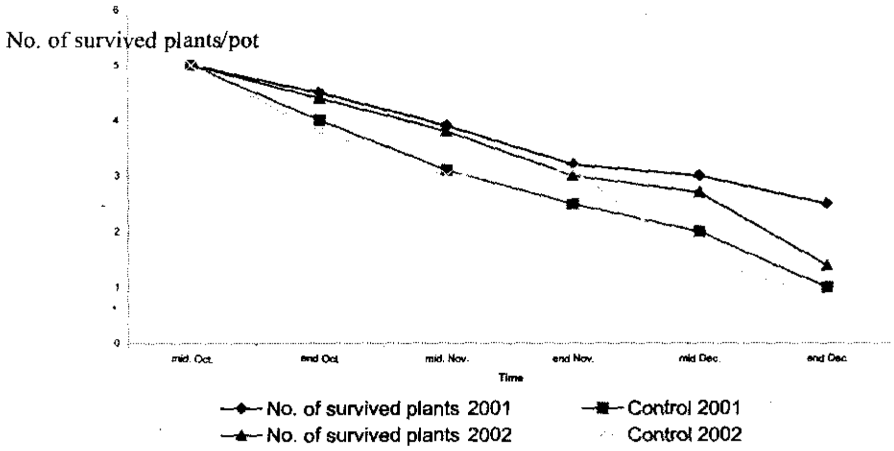

Fig. (5): Effect of S.S on number of survived onion per pot in 2001 and 2002 seasons.

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