TEMPERATURE MODIFICATION IN SOIL OF PLASTIC GREENHOUSE CAUSED BY SOLARIZATION

MODIFICAÇÃO NA TEMPERATURA DO SOLO DE ESTUFA PLÁSTICA CAUSADA PELA SOLARIZAÇÃO

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- SHORT NOTE -

SUMMARY

Temperature modification in soil of plastic greenhouse caused by solarization in the Subtropical Central Region of the Rio Grande do Sul state, Brazil, was measured during the summer. The experiment was carried out in a 10m x 25m greenhouse covered with low density transparent polyethylene (PE). Four 6m x 4m plots were mulched with 100μm thickness PE sheets, from 12/17/92 to 03/07/93. Additional four plots (same size) without covering were used as controls (bare soil). The results showed that solarization raised maximum temperature, on the average, 11.9°C, 10.8°C, 9.8°C, and 8.6°C over uncovered control soil at 2, 5, 10, and 20cm depth, respectively. It was also observed that soil temperature achieved absolute values of up to 54.4°C at 2cm snf 50.2°C at 5cm depth. Temperatures exceeding 45°C and 50°C in solarized soil have also occured in several days.

Key words: solarization, soil temperature, plastic greenhouse.

RESUMO

Quantificou-se a modificação na temperatura do solo de uma estufa plástica causada pela solarização, durante o verão, em Santa Maria, RS. O experimento foi conduzido no interior de uma estufa de polietileno transparente de baixa densidade (PEDB) de 10m x 25m. A solarização foi feita em quatro parcelas de 6m x 4m utilizando PEDB 100μm de espessura, no período de 17/12/92 a 07/03/93. Quatro parcelas de mesmas dimensões foram mantidas sem cobertura (solo desnudo). Os resultados mostram que a temperatura máxima no solo solarizado foi, em média, 11,9°C, 10,8°C, 9,8°C e 8,6°C maior do que no solo não solarizado, nas profundidades de 2, 5, 10 e 20cm, respectivamente. Constata-se também que ocorreram valores absolutos de 54,4°C e 50,2°C nas profundidades de 2 e 5cm, respectivamente, e em vários dias temperaturas que excederam a 45°C e 50°C no solo solarizado.

Palavras-chave: solarização, temperatura do solo, estufa plástica.

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The use of plastic materials to protect horticultural crops in tunnels or greenhouses is a technology of increasing use in the south region of Brazil. This technique leads to repeated plantings of a crop in the same area and, consequently, problems related to soilborne pathogens are expected to occur. Chemical products utilized to control such pathogens are highly toxic and expensive (TOUSSON et al., 1970). Solar heating of soil by mulching with transparent polyethylene (solarization) is a new approach for controlling soilborne pathogens, recently developed by KATAN et al. (1976) in Israel. This is accomplished by mulching moistened soil, during the hot season, with transparent plastic sheets, in order to increase the maximum temperature of the superficial layer of the soil in an attempt to achieve lethal levels to many soilborne pathogens, arthropods, nematodes and weed seeds. Studies carried out in different countries demonstrate the effectiveness of solarization. Advantages of this method are its low cost, simplicity, and the fact that it is nonhazardous. However, its effectiveness depends on the region (solar radiation available during solarization) and the thermal properties of soil, and hence, it should be tested in the place where the technique will be used.

Usually, greenhouses are not used for cropping in January and February in the Rio Grande do Sul state, the best season for solarization in the region. The purpose of this study was to measure temperature modification in soil of plastic greenhouse caused by solarization in the Subtropical Central Region of the Rio Grande do Sul state, Brazil.

The experiment was carried out in a 10m x 25m greenhouse covered with low density transparent polyethylene (PE), located in the Experimental Field of the Crop Production Department of the Federal University of Santa Maria, RS, Brazil (29°41' S latitude, 53°48' W longitude, and 95m altitude). Four 6m x 4m plots were mulched with 100μm thickness PE sheets, from 12/17/92 to 03/07/93. Additional four plots (same size) without covering were used as controls (bare soil). Soil moisture was kept near field capacity in all plots. The greenhouse was kept constantly opened.

Soil temperature was measured throughout the experiment, by means of mercury column glass thermometers, in one replication of nonmulched and covered soil, in the center of the greenhouse. Daily measurements were taken at 9h, 15h30min, 16h, 18h, and 21h, local time, at 2, 5, 10, and 20cm depth. Afternoon measurements corresponded to the time of maximum temperature for 2, 5, 10, and 20cm, respectively.

The results in Table 1 shows that maximum temperature of solarized soil was, on the average, 11.9°C, 10.8°C, 9.8°C, and 8.6°C higher than bare soil at 2, 5, 10, and 20cm depth, respectively. The raise in solarized soil temperature is due to a decrease in sensible and latent heat fluxes leading, consequentely, to an increase in soil heat flux. Furthermore, the greenhouse effect caused by the transparent plastic covering the moistened soil, contribute to this effect (MAHRER, 1979; SCHNEIDER et al., 1993).

As can be noted in the data in Table 1, soil temperature achieved absolute values of up to 54.4°C and 50.2°C at 2 and 5cm depth, respectively. Temperatures exceeding 45°C and 50°C in solarized soil have also occured in several days. Temperatures over 42°C were not observed in bare soil at the depths measured in the experiment. The LD_{90} for ***Verticillium dahliae*** colected from soil in fiel capacity moisture was achieved in a 120 minutes exposure at a temperature of 45°C, while the LD_{90} for ***Rhizoctonia solani*** in PDA medium was 190 minutes. At 50°C, the exposition time was 10 minutes for both soilborne pathogens (PULLMAN et al., 1981).

Table 1 - Absolute (Mx) and mean (M) values of maximum temperature and number of days in which the temperature exceeded 45°C and 50°C (N) in solarized and bare soil of plastic greenhouse. Santa Maria, RS, Brazil. 1992/93.

Treatment	Depth (cm)	Maximum temperature (°C)		N	
		Mx	M	45°C	50°C
Solarization	2	54.4	43.8	41	15
	5	50.2	42.0	22	01
	10	46.0	38.3	01	0
	20	41.2	35.3	0	0
Bare soil	2	40.4	31.9	0	0
	5	37.6	31.2	0	0
	10	33.6	28.5	0	0
	20	29.8	26.7	0	0

The preliminary results obtained in this experiment allows the inference that solarization is a promising method for the Central Region of the Rio Grande do Sul state and is a reasonable approach to be investigated. Many cloudy days were observed during the 1992/93 summer, and the experiment will be repeated in the next years. The effects of soil solarization on tomato crop and some soilborne pathogens will further be evaluated.

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