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SOIL TEMPERATURE MODIFICATIONS CAUSED BY SOLARIZATION IN NURSERIES

MODIFICAÇÃO NA TEMPERATURA DO SOLO CAUSADA PELA SOLARIZAÇÃO EM CANTEIROS

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- SHORT NOTE -

SUMMARY

Solarization effects on soil temperature were evaluated during the autumn. The increase in soil temperature caused by the use of transparent polyethylene (PE) low tunnels over solarized nurseries, in subtropical central region of the Rio Grande do Sul state, Brazil, was also quantified. Treatments were: a) solarization with 100μ thickness PE (T1), b) solarization with 100μ thickness PE, covered with low tunnel (T2), c) solarization with 50μ thickness PE (T3), d) solarization with 50μ thickness PE, covered with low tunnel (T4), and e) bare soil (T). The low tunnel consisted of a 100μ thickness PE and measured 0.5m height in the center of the nursery. The results showed that additional use of low tunnels have increased, on the average, 5.0°C over the maximum temperature of the superficial layer of the soil in the solarized nurseries. In addition, it was observed several days in which the maximum temperature exceeded 45°C.

Key words: solarization, soil temperature, nurseries, low tunnels.

RESUMO

Avaliou-se o efeito da solarização sobre a temperatura do solo durante o outono e quantificou-se o acréscimo na temperatura do solo resultante do uso de túneis baixos de polietileno transparente (PEBD) em canteiros solarizados, em Santa Maria, RS. Os tratamentos foram: a) solarização com PEDB 100μ de espessura (T1), b) solarização com PEDB 100μ de espessura e coberto com túnel baixo (T2), c) solarização com PEDB 50μ de espessura (T3), d) solarização com PEDB 50μ de espessura e coberto com túnel baixo (T4) e e) solo desnudo (T). O túnel baixo foi coberto com PEDB de 100μ de espessura e tinha 0,5m de altura no centro do canteiro. Os resultados mostraram que o uso adicional de túneis baixos sobre os canteiros solarizados aumentou, em média, 5,0°C a temperatura máxima na camada superficial do solo e que ocorreram vários dias com temperatura máxima superior a 45°C.

Palavras-chave: solarização, temperatura do solo, canteiros, túneis baixos.

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. It consists of covering moistened soil, during summer months, with transparent plastic films, to increase the temperature of the superficial layer of the soil to a level enough to kill certain soilborne pathogens for some time (minutes, hours), during several days.

In the production of tobacco seedlings, fumigation with methyl bromide is used to sterilize the soil. This product is expensive, toxic and gaseous. Simple, inexpensive, nonhazardous methods, such as solarization, should be tested. For tobacco, the time between the best season to applicate solarization (December to February) and its sowing (May and June) is quite long, what makes this method difficult to use. The objective of this study was to evaluate the effect of solarization on the soil temperature during the autumn in the subtropical central region of the Rio Grande do Sul state. In addition, it was measured the raise in soil temperature of solarized nurseries, caused by the use of transparent polyethylene low tunnels.

The experiment was carried out in the

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Experimental Field of the Crop Production Departament of the Federal University of Santa Maria, Santa Maria, RS, Brazil (29°41'S latitude, 53°48'W longitude, and 95m altitude). Treatments, applied on 6.00m x 1.80m x 0.15m nurseries, were: a) solarization with 100μ thickness transparent polyethylene - PE - (T1), b) solarization with 100μ thickness PE, covered with low tunnel (T2), c) solarization with 50μ thickness PE (T3), d) solarization with 50μ thickness PE, covered with low tunnel (T4), and e) bare soil (T). The low tunnel consisted of a 100μ thickness PE and measured 0.5m height in the center of the nursery. The experimental period was from 03/24/1993 to 05/17/1993, out of the best season for solarization in the region.

Soil temperature was measured at 2cm and 5cm depths by means of a mercury column glass thermometer, in the center of each nursery. Daily measurements were taken at 9h, 15h30min, and 16h, local hour, where the last two corresponded to the time of maximum temperature for 2cm and 5cm depths, respectively (SCHNEIDER, 1979). Soil moisture was kept near field capacity in all nurseries.

The results in Table 1 shows that soil temperature was not significantly affected by plastic thickness and that mean values of maximum temperature in solarized soil (T1 and T3) were 7.7°C and 6.5°C higher than bare soil in 2cm and 5cm 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 higher greenhouse effect caused by the transparent plastic covering the moistened soil, inhanced this effect (MAHRER, 1979; SCHNEIDER et al, 1993).

It is noted, however, that temperatures higher than 45°C, at 2cm depth in solarized soil without low tunnel, occured only in 3 days. This fact makes the usual solarization method in the autumn unfeasible in the central region of the Rio Grande do Sul state. At a temperature of 45°C, the LD_{90} for **Verticillium dahliae** collected from soil in field capacity moisture was achieved in 120 min. For **Rhizoctonia solani** cultures in PDA medium, exposition time was 190 min (PULLMAN et al, 1981).

Using transparent plastic low tunnels over solarized soil (T2 and T4) was shown to be effective in raising temperature, as it was possible to increase 5.0°C over the maximum temperature, regardless the measure depth. It was also observed several days in which the maximum temperature exceeded 45°C, in both depth studied, and much more frequently than the usual solarization (without low tunnel). These results allows the inference that using low tunnel over solarized nursery, out of the recomended season, is a reasonable approach to be investigated in relation to tobacco plant response, controlling of pathogens and physical, chemical and microbiological modifications of soil.

TABLE 1 - Maximum (Mx) and mean (M) values of maximum temperature of solarized (T1, T2, T3, and T4) and bare soil (T) and the number of days in which the temperature exceeded 45°C (N > 45°C). Santa Maria, RS, Brazil.

Treatment	Depth (cm)	Maximum Temperature (°C) Mx	M	N > 45°C
T1*	2	49.6	35.0	3
	5	41.8	32.2	0
T2*	2	51.8	40.3	14
	5	48.6	37.3	7
T3*	2	46.1	34.5	3
	5	40.8	31.5	0
T4*	2	50.2	38.9	10
	5	48.2	36.4	6
T*	2	34.6	26.8	0
	5	30.6	25.0	0

* T1 = solarization with 100μ thickness transparent polyethylene (PE);
T2 = solarization with 100μ thickness PE, covered with low tunnel;
T3 = solarization with 50μ thickness PE;
T4 = solarization with 50μ thickness PE, covered with low tunnel.
T = bare soil

REFERENCES

KATAN, J., GREENBERGER, A., ALON, H. et al. Solar heating by polyethylene mulching for control of diseases caused by soil borne pathogens. **Phytopathology**, v. 66, p. 683-688, 1976.

MAHRER, Y. Prediction of soil temperature of a soil mulched with transparent polyethylene. **Journal of Applied Meteorology**, v. 18, p. 1263-1267, 1979.

PULLMAN, G.S., DEVAY, J.E., GARBER, R.H. Soil solarization and thermal death: a logaritmic relationship between time and temperature for four soilborne pathogens. **Phytopathology**, v. 71, n. 9, p. 959-964, 1981.

SCHNEIDER, F.M. **Comportamento e propriedades térmicas do solo Santa Maria** Piracicaba, SP, 1979. 77 p. Dissertação (Mestrado em Agrometeorologia), Escola Superior de Agricultura "Luiz de Queirós", 1979.

SCHNEIDER, F.M., STRECK, N.A., BURIOL, G.A. Modificações físicas causadas pela solarização do solo. **Revista Brasileira de Agrometeorologia**, Santa Maria, v. 1, n. 1, p. 149-157, 1993.