SOIL TEMPERATURE AS AFFEC17ED BY SOIL SOLARIZATION IN A HUMID CLIMATE

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Soil solarization has been effective in controlling soil-borne pests in and climates. With the impending ban on methyl bromide, the possibility of extending soil solarization to the humid, cloudy climate of Florida has been investigated with promising results. In an effort to enhance the performance of soil solarization under Florida's climatic conditions, solarization films were selected with the intention of maximizing soil heating by decreasing radiative loss and convective loss. The materials selected were thermal infrared-absorbing OR) polyethylene films and bubble film. Solarization trials were conducted at Quincy (north Florida), Gainesville (north-central Florida) and Bradenton (central Florida, Gulf coast) in summer 1996, and at Gainesville and Bradenton in winter 1997. The soil types at the three sites were Orangeburg fine sandy loam (fine loamy, siliceous, thermic, Typic Paleudults), Arredondo fine sand (loamy, siliceous, hyperthermic, Grossaremc Paleudults) and EauGallie fine sand (siliceous, hyperthermic, alfic, Haplaquod), respectively.

Soil temperature was measured using CR10 dataloggers (Campbell Scientific, Logan, Utah) outfitted with thermocouples that were inserted in the soil at the surface, and at 5, 10 and 25 cm. depths. Temperatures were recorded at 30 minute intervals except at Quincy where the 10 and 25 cm, depths were measured hourly. We have determined in the laboratory, that 50°C for 6 h per day will kill purple and yellow nutsedge (Cyperus spp.) tubers within a two week period. Although 45°C delayed shoot emergence, it was not lethal to nutsedge tubers. In the field, during solarization, tubers that are located at depths that do not heat to lethal temperature, produce rhizomes that differentiate into shoots on detection of light as they emerge. from the soil. The shoots are trapped under the transparent solarization film and are killed by foliar scorching.

In summer 1996, 100 µm IR film was used at all 3 sites. Bubble film stabilized against ultra-violet radiation (UV-bubble) was used at Quincy and Bradenton. At Gainesville, the bubble film was not UV- and so it was overlaid with 30 µm clear low density polyethylene (LDPE) film. The soil temperatures measured under these two films were compared with those obtained with conventional black polyethylene mulch at Gainesville and Bradenton and the clear LDPE film. At Quincy the black film was of gas impermeable LDPE. At Gainesville solarization occurred for 33 days from day 194 to day 226. For Gainesville because of equipment malfunction, temperature data were available for the first 10 days and the last 13 days of the solarization period. Solarization was conducted at Quincy for 54 days beginning on day 159 of the year and for 48 days at Bradenton from day 200 to day 247. However, only the data collected over the first 33 days of solarization for Quincy and Bradenton were used for comparison with the Gainesville data.

The highest soil temperatures were recorded at Quincy. The mean daily maximum temperatures at the soil surface were 61.5, 58.3, 60.5 and 59.3 °C for black, clear, IR and LJV-bubble films, respectively. At 5 cm depth the mean daily maximum temperatures were 41.1, 46.9, 47.7 and 45.6°C, respectively. Under IR film, at 5 cm depth, there were 14 dais with temperatures over 50°C. For clear and UV-bubble, there were only 9 and 8 days over 50°C; and temperatures were always below 50°C for black film.

The lowest temperatures occurred at Bradenton, where subsurface irrigation was used through the solarization period. The black plastic mulch resulted in the lowest soil temperatures. The mean maximum temperatures under UV-bubble film at 5 and 10 cm were slightly higher than those under clear LDPE, but not at the surface where temperatures under the clear film was 2 degrees warmer. Higher soil temperatures were achieved under IR film than under the clear LDPE. Mean daily maximum temperatures at the soil surface and 5 cm were 58.4 and 49.3 °C for IR film, and 55.2 and 47.0 for clear IDPE film.

At Gainesville, IR and clear IDPE films gave similar soil temperatures except at the soil surface where IR had a mean daily maximum that was 2 degrees higher than the clear LDPE The IR film also resulted in 14 days with maximum surface temperatures in excess of 60°C, compared with 6 days for the clear LDPE. The bubble film overlaid with clear IDPE resulted in lower maximum temperatures than clear LDPE by itselt, but produced higher minimum sod temperatures. At all three locations, temperatures under the specialty films were sufficiently high to eliminate annual weeds and to suppress purple and yellow nutsedge. The thermal IR film, in particular, consistently gave higher temperatures than clear IDPE and appears to have excellent promise for weed management in Fall-produced vegetable crops.

The specialty films were also evaluated at Bradenton and Gainesville during the cool season. Infrared film (100 µm) was installed on 12/19/96, 1/2/97 and 1/17/97 to give durations of 5, 7 and 9 weeks of solarization. UV-bubble was also installed for the 9 week duration only. On 1/23/97 at Gainesville 50, 75 and 100 µm IR were installed and compared with UV-stabilized bubble film, black and a 19 µm clear high density polyethylene (HDPE) film, over an 8 week solarization period. The specialty films increased soil temperatures during winter solarization at both sites. However, temperature increases were not as pronounced in the winter as in the summer. There was only a limited amount of damage to emerged weeds. Emerged weeds included annuals such as goosegrass, crowfootgrass and pigweed and perennials such as nutsedge. In fact, the warmer temperatures of the solarization beds may have been advantageous for rapid weed growth. The results of winter solarization at two Florida sites were not encouraging for use of soil solarization for weed control in cool season crop production.

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