# A NEW APPROACH TO FUMIGATING SOILS UNDER RAISED, PLASTIC MULCHED BEDS

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A farm implement was designed and constructed to permit the application of soil fumigants under raised beds covered by plastic mulch. This device, referred to as the 'Mirusso-Chellemi Under Bed Fumigator', delivers fumigants to the interior of raised, plastic mulch beds from an injection point in the row middles without disturbing the integrity of the beds or the use of a drip irrigation system. Worker exposure to chemicals and the constraints associated with Protective Equipment (PPE) requirements are mitigated because fumigation can be performed after the planting beds are prepared and workers have vacated the field.

The 'Mirusso-Chellemi Under Bed Fumigator' was field tested for the application of a 61:35 mixture of 1,3-dichloroproene:chloropicrin (Telone C35) under raised beds covered by low density polyethylene (LDPE) or virtually impermeable films (VIF). A 7-day soil solarization treatment prior to fumigant application was also evaluated (Table 1).

Table 1. Treatments included in the experiment

| | Telone C-35 | | Solarization |
|---|---|---|---|
| Plastic | rate* | Timing | treatment |
| clear, LDPE** | 0 gal/A | ---- | 7 days |
| clear, LDPE | 35 gal/A | 7 day delay | none |
| clear, VIF | 0 gal/A | ---- | none |
| clear, VIF | 35 gal/A | 7 day delay | 7 days |
| white, LDPE | 0 gal/A | ---- | 7 days |
| white, LDPE | 35 gal/A | at bed formation | none |
| black, VIF | 35 gal/A | 7 day delay | none |
| black, VIF | 35 gal/A | at bed formation | none |

*broadcast acre rate
**LDPE = low density polyethylene film, VIF = virtually impermeable film.

The experiment was conducted at the USDA, ARS Header Canal Research Farm located in St. Lucie County, Florida. The soil type was a Riviera fine sand (93% sand, 4% silt, and 3% clay) with an organic matter content of less than 2% and a pH of 6.9. The LDPE films were 1.2 mil (30 µm) thick and embossed. The VIF (Hytibarrier flex, Klerks Plastic Products Manufacturing Co,, Richburg, SC) were 1.4 mil thick (35 µM) and smooth. Treatments were arranged in a randomized complete block design and replicated four times. Each replicate plot was a single row, 100 ft (33 m) long. Rows were arranged on 6 ft (2 m) centers. Bed dimensions were 32 inches wide and 10 inches high (80 x 25 cm). At 7 days after application, the clear and black plastic films were painted white with a latex based paint (Kool Grow, SunTec Paints, Gainesville, FL). Twenty five tomato (Florida 91) and 25 pepper (Enterprise) seedlings were transplanted into the

center of each replicate plot with a 20 inch (50 cm) spacing between plants. The crops were maintained using standard production practices.

Concentrations of 1,3-dichloropropene in the soil atmosphere were measured using a Gastec Model GV-100 gas sampling pump equipped with #139 dichloroethylene detector tubes (Gastec Corporation, Ayase-City, Japan). A 2X correction factor was used to adjust the tube readings for 1,3-dichloropropene according to manufacturers instructions. Samples were collected immediately after removal of a 5 x 1 inch (12.5 x 2.5 cm) core of soil. Samples were collected at 8-inch (20 cm) increments across the beds and row middles at 24, 48, and 72 hr after application. Survival of *Fusarium oxysporum f.sp. lycopersici* and *Phytophthora capsici* in the bed centers was determined by burying bags containing inoculum at a 2 inch depth. The effect of the fumigant application on control of weeds, soilborne diseases, plant parasitic nematodes, and marketable yields were determined.

The 'Mirusso-Chellemi Under Bed Fumigator' was able to apply Telone C35 underneath the raised, plastic mulched beds without disturbing the integrity of the beds. The beds remained intact through out the duration of the growing season, indicating no disruption their internal structure. Applications were made at a tractor speed of 4 mph (6.4 kph), which is considered satisfactory for pesticide application. No physical wear was observed on any components of the Mirusso-Chellemi Under Bed Fumigator during or after the experiment. Under the VIF, concentrations of 1,3-dichloropropene in the soil atmosphere reached a maximum of 180 PPM at 48 hours after application (Fig. 1). Concentrations of 1,3-dichloropropene under the LDPE film remained less that 12 PPM.

Emergence of yellow and purple nutsedge was significantly reduced when Telone C35 was applied using the Mirusso-Chellemi Under Bed Fumigator (Fig. 2). Additional control was achieved when the fumigant application was made under VIF or following a 7-day soil solarization period. Survival of *F. o. lycopersici* was significantly reduced when the fumigant application was combined with VIF or a 7-day pre-soil solarization period. Marketable yield of tomato and pepper were highest in treatments were fumigants were applied under VIF or following a 7-day pre-soil solarization treatment. The results indicate a synergistic response to pest control and marketable yield occurs when soil fumigation is combined with a 7-day pre-soil solarization period or VIF. The 'Mirusso-Chellemi Under Bed Fumigator' facilitates the combination of pest control tactics.

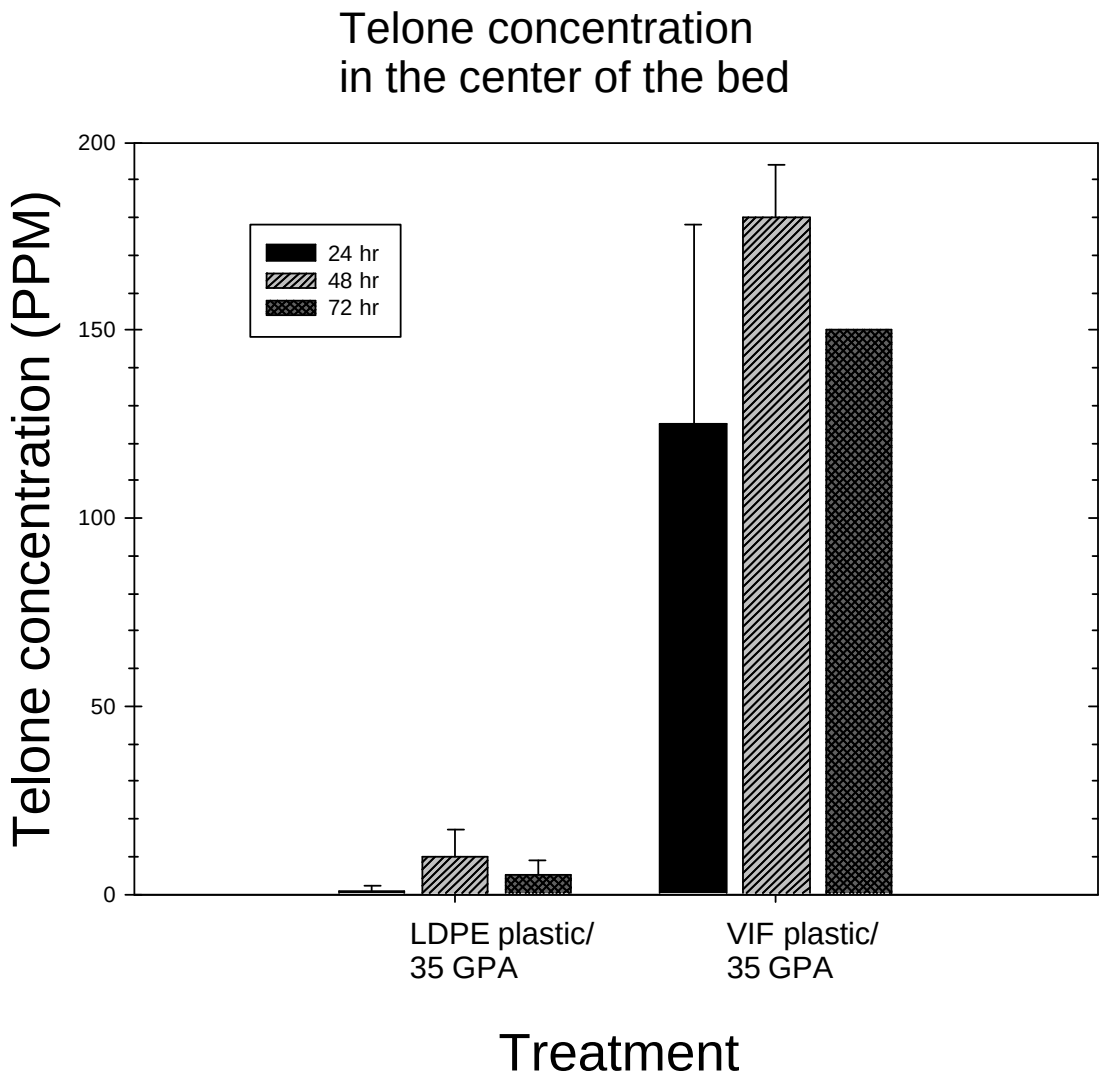
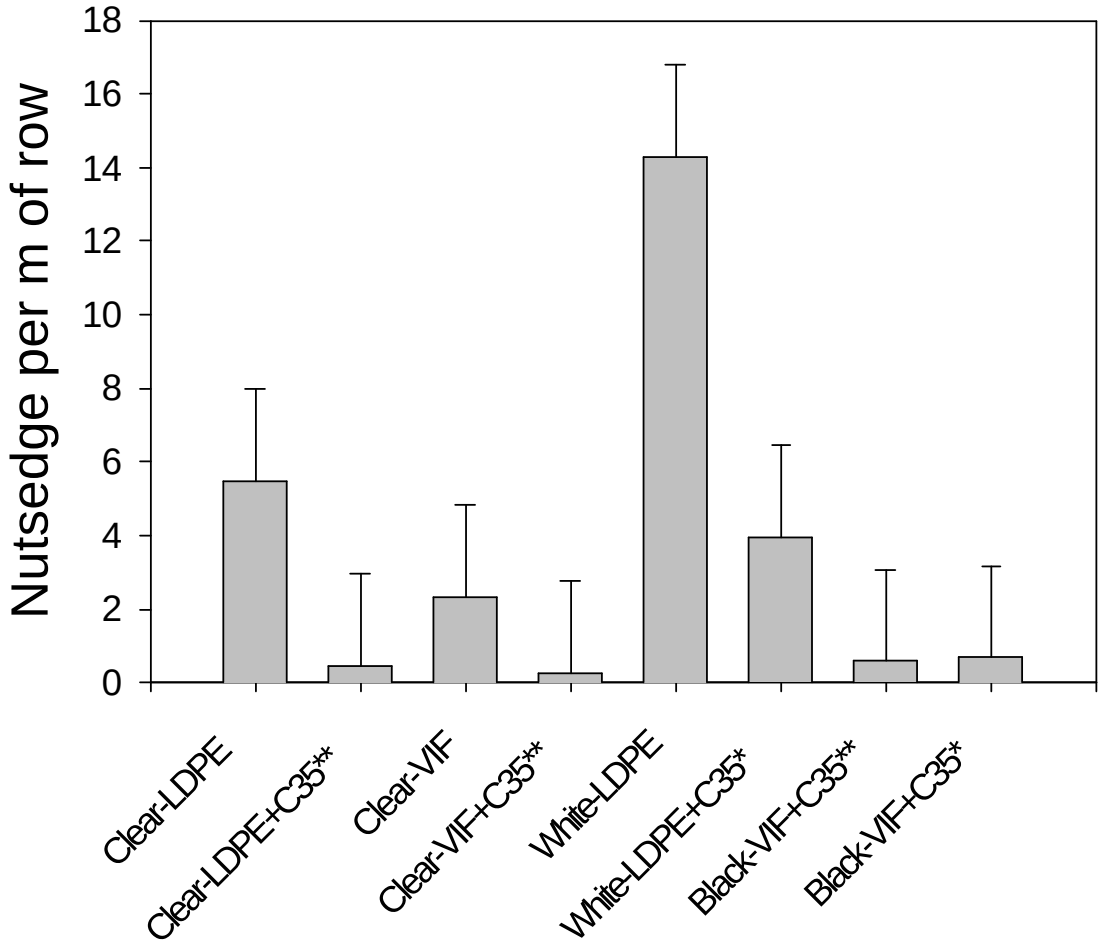



Figure1. The concentration of Telone (1,3-dichloropropene) under raised beds covered by LDPE (low density polyethylene) or VIF (virtually impermeable film) following application with the Mirusso-Chellemi Under Bed Fumigator.




LDPE - low density polyethylene plastic
VIF = virtually impermeable film
All clear films received a 7 day soil solarization period
C35 = Telone C35

*C35 applied the same day beds were prepared

**C35 applied after 7 days

Figure 2. Emergence of nutsedge sprouts under different combinations of fumigant (Telone C35 = 1,3 dichloropropene), plastic film, and a soil solarization treatment. Fumigant applied using the Mirusso-Chellemi Under Bed Fumigator.