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SOIL SOLARIZATION AND AMENDMENT USING CLOVE (*SYZYGIUM AROMATICUM)* IN CONTROL OF *Fusarium Oxysporum f. sp. Lycopersici*

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ABSTRACT

Soil treatment using solarization and amendment with ground clove *(Syzygium aromaticaum)* was carried out in a screen house experiment to control *Fusarium oxysporum f. sp. Lycopersici*. The study evaluated two thickness of clear polyethylene plastic, two concentrations of ground clove as well as a combination of the treatments. Colony counts for *F. oxysporum* was carried out for samples from all treatments and the highest count of 1.8 x 10^5 cfu/g was observed from the control. There was reduction in colony over the eight week period.

INTRODUCTION

Solarization is a simple nonchemical technique that captures radiant heat energy from the sun. This energy causes physical, chemical, and biological changes in the soil. These changes lead to control or suppression of soil borne plant pathogens such as fungi, bacteria, nematodes, and pests along with weed, seed and seedlings. Soil solarization was first described in 1976 by Katan *et al.*, for controlling soil borne pathogens and weeds, mostly as a pre-planting soil treatment. It was achieved by covering (mulching, tarping) the soil with transparent polyethylene during the hot season, thereby heating it and killing the pests.

Fusarium oxysporum, also referred to as panama disease or Agent Green, is a fungus that causes *Fusarium* wilt disease in more than hundred species of plant. Important Fusarium diseases include: Banana wilt; Panama wilt *(F. ozysporum f. sp. Cubense);* Fusarium wilt of cotton *(F. oxysporum f. sp. Vasinfectum);* Fusarium wilt of sweet potato; Stem root (*F. oxysporum f. sp. Batatas);* Fusarium wilt of tomato *(F. oxysportum f. sp. Lycopersici)* and Fusarium yellows of common beans *(F. oxysporum f. sp. Phaseoli).*

The fungi spread into the water conducting tissue (xylem) in the stem and block the flow of water to the foliage. As a result of this blockage and breakdown of xylem, symptoms appear in plants such as leaf wilting, yellowing and the plant dies. A cut through the cover stem of dead plant often reveals a brownish discoloration of the vascular tissue (Fravel *et al.*, 2003). A wide range of vegetables, plantation crops, non-materials and turf grasses are attacked by the disease. Tomato and other solanaceous crops, sweet potato, legumes, cucurbits and banana are the most susceptible plants but it will also infect other herbaceous plants. Hosts of *Fusarium oxysporum* include; potato, sugarcane, garden bean, cowpea, prickly pea and *Musa sp.* (Raabe *et al.,* 1981). Food production decisions are made mainly by small scale farmers who represent 95 percent of the total food crop farming units in Nigeria and they produce about 90 percent of the total food output (Adejobi, 2004). These farmers use two principal resources, land and labour, others are owned and borrowed capital and purchased inputs; agro-chemical, fertilizer, etc and are often faced with severe price and yield variation. Resources limitations result in the subsistence farmers in the southern part of Nigeria to refrain from planting solanaceous crops that are susceptible to a host of diseases and soil borne pathogens (pers comm.).

This study was carried out to compare the effectiveness of the two thickness of transparent polyethylene as an effective material for solarization; evaluate the performance of two concentrations of clove extracts on the population of microorganisms in the soil; and also to evaluate the performance of combination of treatment using polyethylene and clove extracts on the colony of Fusarium and other microorganisms in the soil.

MATERIALS AND METHODS

Two transparent polyethylene of single layer of thickness 1.1mm and 1.5mm were used. Ten and 20g of *Syzygium aromaticum* was used as soil treatment. The *S. aromaticum* spice was ground using a hand mill (coroma) and ground spice were stored at 4^{o}C till required.

Treatments

Top soil was collected from the farm (sandy-loam) and sieved to remove stones, the soils were then put in experimental pots (15 cm height and 15cm diameter). All nine treatments were inoculated with 1 Petri-dish of a 7-day culture of *Fusarium oxysporum f. sp. Lycopersici* before the introduction of treatments. The treatments were: 1.1mm polythene; 1.5mm polythene; 10g clove + 1.1mm polythene; 10g clove; 20g clove; Pathogen alone (Control). All polythene treatments were secured using rubber bund to the pots. All treatments were placed in an open-field under direct sunlight.

Bioassay

Soil samples from each treatment were collected, the samples were bulked and 1g sample from each treatment were analyzed using the serial dilution technique. Microbial counts were carried out 48-72h later. Colonies were allowed to grow for 1 week for identification of colonies.

RESULT

Comparison of means of isolated microorganisms at wk-2 of the study showed that the colony count of Fusarium oxysporum f. sp. Lycopersici was significantly higher than those of other fungi isolated at 5% level of probability (Table 1) with counts of 1.01 x 10^5 and *Penicillium* sp. *Aspergillus flavus* and *A. niger* having 0.7; 0.76 and 0.87 x 10^5 cfu/g of treated soils respectively. Over the 8 wk observation, there was a significant decrease in *F. oxysporum* colony count from wk-2 to wk-4 as well as wk-6 (Table 2). A total count from the soils showed significant decline over time (Table 3). Using square root transformation of data, analysis showed a steady decline in the microbial load over time for the 1.1mm and 1.5mm treatments. By wk-8, there was significant reduction in microbial load and when compared to the control 0.75 (1.1mm); 0.79 (1.5mm) and 1.53 (control). Treatment is clove (10g and 20g) showed significant effect from the control at wk-2 and wk-8 (Table 4).

Table 1: Mean Comparison of isolated microorganisms from serial dilution at week 2 of soil inoculated with *Fusarium axysporum f. sp lycopersici*

Microorganisms	Colony count (cfu/g) x 10^5
F. oxysporum	1.019c
Unidentified fungus (about 8 Genera)	4.169a
Bacterial isolates	1.454b
A. niger A.	0.869d
flavus	0.759e
Penicillium	0.753e

Means followed by the same letters are not significantly different from each other at 5% level of significance.

Table 2: Microbial load (cfu/g) over time for the pathogen *(F. oxysporum. f.sp lycopersici)* and other microorganisms isolated

Microorganism	Week 2	Week 4	Week 6	Week 8
F. oxysporum	1.392c	0.991d	0.811e	0.881e
Other fungus	3.313a	3.970a	4.476a	4.978a
Bacteria	1.268c	1.617b	1.675b	1.258c
A. niger	0.787e	0.875e	1.008d	0.806e
A. flavus	0.721e	0.798e	0.798e	0.721e
Penicillium	0.730e	0.743e	0.819e	0.720e

Mean followed by the same letters are not significantly different from each other at 5% level of significance.

Table 3: Total microbial load from all microorganisms isolated from treated soils over an eight-week period

Week	Microbial count (cfu/g)x 10^5
2	1.369b
4	1.499b
5	1.598a
8	1.551a

Means followed by the same letters are not- significantly different at 5% level of probability.

Table 4: Microbial count of *Fusarium ozysporum f. sp. Lycopersici* from treated soil over an 8-week period

Microorganism	Week 2	Week 4	Week 6	Week 8
1.1mm Polyethylene	3.2847a	1.4262bc	0.8338ab	0.7479bc
1.5mm Polyethylene	1.1393f	1.0604c	0.9352b	0.7887c
10g/Clove, 1.1mm Polyethylene	0.7071f	0.7071c	0.7071b	0.7071c
20g/Clove, 1.1mm Polyethylene	0.7071f	0.7071c	0.7071b	0.7071c
10g/Clove, 1.5mm Polyethylene	0.7479ef	0.7071c	0.7071b	0.7071c
20g/Clove, 1.5mm Polyethylene	0.7887c	0.7071c	0.7071b	0.7071c
10g/Clove	1.1777e	0.9385c	0.8514ab	1.0795b
20g/Clove	1.0762b	1.3630ab	0.7479ab	0.9549bc
Pathogen alone	2.8969	1.3028b	1.1137a	1.5256a

LSD = 0.36218 Transformed Data (Using Square root method) by adding 0.05 to all the values. Mean with different letters as significantly different at 5% level of probability.

DISCUSSION

The study showed that all the treatments were effective against the pathogen *F. oxysporum f. sp lycopersici* with 10g clove, 1.1mm polyethelene being the most effective accounting for the least colony count followed by 10g clove, 1.5mm polyethylene and 20g clove, 1.5mm polyethylene.

Using single layer transparent polyethylene alone 1.1mm polythene has a lower colony count when compared with the 1.5mm polyethylene while for the clove concentrations, 20g clove has a lower colony count than 10g clove.

Ashworth and Ganoa (1982), found that thinner transparent PE films (1 to 1.5mm) have been more effective in solar heating of soil than thicker films (2 to 6 mm) or black PE film in the control of *F. oxysporum.*

Vuida *et al*., (2007), reported antifungal potential of essential oils of oregano, thyme, and clove presented inhibitory effects in *Alternaria brassicicola*, *F. oxysporum* and *X. compestris,* using different concentration of the extracts. He found that the clove extract with more concentration provided a more inhibitory effect on *F. oxysporum*, this was also reported by Pawa and Thaker (2006) which Chami *et al*., (2005), attributed to eugenol, the major component of clove oil.

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