ASSESSING THE EFFECTIVENESS OF SOIL SOLARIZATION FOR THE CONTROL OF SOILBORNE PLANT PATHOGENS AND WEEDS

By

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A thesis submitted in partial fulfillment of the requirements of the degree of Master of Science in Crop Protection

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The undersigned certify that they have read, and recommended to the Department of Crop Science for acceptance, the thesis entitled:
Assessing the effectiveness of soil solarization for the control of soilborne plant pathogens and weeds.

Submitted by **ELIZABETH NGADZE** in partial fulfillment of the requirements of the degree of **Master of Science in Crop Protection.**

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ABSTRACT

A field experiment was carried out at the Department of Crop Science, University of Zimbabwe in the 2003/2004 season to investigate the effectiveness of solarization on the control of soilborne plant pathogens and weeds. The well prepared and pre-irrigated plots were (i) covered with clear (ii) black plastic mulch for 8 weeks during the months of October to December (iii) fumigated with methyl bromide at 30g m^{-2} or (iv) left untreated. The experiment was conducted in a randomized complete block design with four replications per treatment. The soil from the different treatments was sampled at pre-treatment and fortnightly for the 8-week period and analyzed for bacterial and fungal types and populations. The soil was also incubated in the greenhouse and the weeds, which germinated, were identified, counted and recorded according to species. Weed identification and counts were also carried out in the field during the 8 week period. After the solarization period, plastic mulches and all weeds were removed. A bean crop (*Phaseolus vulgaris*) was planted in the solarized soil. Diseases on the bean crop were assessed weekly for 4 weeks; weed density at 5 weeks after crop emergence (WACE), number of flowers $plant^{-1}$ at 5 WACE, number of pods $plant^{-1}$ at 10 WACE, number of seeds pod^{-1} at 13 WACE and yield at harvesting maturity were determined. The clear plastic mulching consistently recorded significantly ($P<0.05$) high soil temperatures compared to the other treatments. The average maximum temperature was 55^0C and the average minimum temperature was 32^0C under the clear plastic. These temperatures were more than those achieved in the other treatments. Plastic mulches and fumigation significantly ($P<0.05$) reduced all weed species both in the greenhouse and in the field. The untreated soil recorded the highest total weed counts averaging 160 weeds m^{-2} while no weed species survived under the clear and black plastic mulches. Fumigation and the plastic mulches significantly reduced ($P<0.05$) most fungi species. The untreated soil had the highest fungal counts which averaged 30 colony forming units $gram^{-1}$ ($cfug^{-1}$) of soil, while fumigated soil recorded 0 $cfug^{-1}$, black plastic 1.2 $cfug^{-1}$ and clear soil recorded 0.8 $cfug^{-1}$. Clear plastic mulches significantly ($P<0.05$) increased the populations of *Aspergillus* and *Penicillium*, by about 25%. Mulching had no effect on the populations of *Bacillus* and *Actinomycetes* but significantly ($P<0.05$) reduced the other species of bacteria that were present in the soil. No colonies were recorded in fumigated soil and 5 cfus were recorded in untreated soil. *Fusarium* wilt incidence and severity on the bean crop were significantly ($P<0.05$) reduced on the plots previously mulched with plastics. Soil treated with clear and black plastic mulches recorded the least disease incidence of 7% and 5% respectively, while fumigated soil recorded an incidence of 30% and 45% was recorded in untreated soil. Yield of field beans (*Phaseolus vulgaris*) from plots mulched with plastic was significantly ($P<0.05$) increased, compared to the methyl bromide and untreated plots, 3 tha^{-1} and 2.7 tha^{-1} were harvested from soils mulched with clear and black plastic mulches respectively, 1.8 tha^{-1} was harvested from fumigated soil and 1.6 tha^{-1} was harvested from untreated soil. Solarization was effective in reducing weeds and soilborne pathogens. Leaf area and bean yield increased in the soils covered with plastic mulches compared to fumigation and untreated soil.

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