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Anaerobic Soil Disinfestation: Feasible Alternative to Soil Chemical Fumigants

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Abstract : Phytophthora nicotianae is the principal causal agent of root and crown rot disease of red pepper plants in Extremadura (Western Spain). There is a need to develop a biologically-based method of soil disinfestation that facilitates profitable and sustainable production without the use of chemical fumigants. Anaerobic Soil Disinfestation (ASD), as well know as biodisinfestation, has been shown to control a wide range of soil-borne pathogens and nematodes in numerous crop production systems. This method implies soil wetting, incorporation of a easily decomposable carbon-rich organic amendment and covering with plastic film for several weeks. ASD with rapeseed cake (var. Tocatta, a glucosinolates-free variety) used as C-source was assayed in spring 2014, before the pepper crop establishment. The field experiment was conducted at the Agricultural Research Centre Finca La Orden (Southwestern Spain) and the treatments were: rapeseed cake (RCP); rapeseed cake without plastic cover (RC); control non-amendment (CP) and control non-amendment without plastic cover (C). The experimental design was a randomized complete block design with four replicates and a plot size of 5 x 5 m. On 26 March, rapeseed cake (1 kg·m-2) was incorporated into the soil with a rotovator. Biological probes with the inoculum were buried at 15 and 30-cm depth (biological probes were previously prepared with 100 g of disinfected soil inoculated with chlamydospores (chlam) of P. nicotianae P13 isolate [100 chlam·g-1 of soil] and wrapped in agryl cloth). Sprinkler irrigation was run until field capacity and the corresponding plots were covered with transparent plastic (PE 0.05 mm). On 6 May plastics were removed, the biological probes were dug out and a bioassay was established. One pepper seedling at the 2 to 4 true-leaves stage was transplanted in the soil from each biological probe. Plants were grown in a climatic chamber and disease symptoms were recorded every week during 2 months. Fragments of roots and crown of symptomatic plants were analyzed on NARPH media and soil from rizospheres was analyzed using carnation petals as baits. Results of “survival” were expressed as the percentage of soil samples where P. nicotianae was detected and results of “infectivity” were expressed as the percentage of diseased plants. No differences were detected in deep effect. Infectivity of P. nicotianae chlamydospores was successfully reduced in RCP treatment (4.2% of infectivity) compared with the controls (41.7% of infectivity). The pattern of survival was similar to infectivity observed by the bioassay: 21% of survival in RCP; 79% in CP; 83% in C and 87% in RC. Although ASD may be an effective alternative to chemical fumigants to pest management, more research is necessary to show their impact on the microbial community and chemistry of the soil.

Keywords : biodisinfestation, BSD, soil fumigant alternatives, organic amendments
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