pathogens

Review

Can Anaerobic Soil Disinfestation (ASD) be a Game Changer in Tropical Agriculture?

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Abstract: Anaerobic soil disinfection (ASD) has been identified as an alternative soil-borne pathogen control strategy to chemical fumigation. ASD involves the application of an easily liable carbon source followed by irrigation to field capacity and maintenance of an anaerobic condition for a certain period. A literature search undertaken on ASD found that more than 50 comprehensive research projects have been conducted since its first discovery in 2000. Most of these studies were conducted in the USA and in the Netherlands. Though the exact mechanism of ASD in pathogen control is unknown, promising results have been reported against a wide range of pathogens such as fungi, nematodes, protists, and oomycetes. However, it is interesting to note that, except for a few studies, ASD research in the developing world and in the tropical countries has lagged behind. Nevertheless, with soil quality depletion, reduction in arable lands, and exponential population growth, a drastic change to the current agricultural practices should be adapted since yield gain has reached a plateau for major staple crops. Under such circumstances, we identified the gaps and the potentials of ASD in tropical agricultural systems and proposed promising biodegradable materials.

Keywords: soil-borne pathogens; chemical fumigation; anaerobic soil disinfestation; ASD; C source

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1. Introduction

Crops are often attacked by various plant pathogens, plant-parasitic nematodes, insect pests, and weeds causing great economic losses around the world. Among diverse groups of plant pathogens, soil-borne phytopathogens pose a great threat to crop production [1–3]. Although soil is a home for billions of living organisms (both macro and microorganisms), they must face a multitude of challenges such as flood, drought, and agricultural practices. However, soil-borne pathogens can survive under these challenges and cause serious crop damage around the world. For example, waterlogged agricultural fields may be unfavourable for many organisms but favourable for root-infecting fungi and oomycetes such as *Pythium* and *Phytophthora* spp. [4–6]. Although drought conditions are unfavourable for most of the organisms, soil-borne pathogen species such as *Fusarium* spp. and *Verticillium* spp. [5] manage to cause severe infections. Hence, soil-borne phytopathogens show a great deal of evolutionary adaptations. They can survive in the soils for many years in the absence of host plants through the formation of resistant structures such as microsclerotia (*Verticillium* spp.), sclerotia (*Sclerotinia* spp.), chlamydospores (*Fusarium* spp.), or oospores (*Phytophthora* spp.) [7–10]. Microsclerotia and sclerotia have the same anatomical structure, consisting of outer melanized parenchyma cells and inner colorless medullary cells, and are asexual in nature. Chlamydospores are thick-walled asexual survival structures whereas oospores are thick-walled sexual structures with food reserves for better survival. These structures may be melanised or non-melanised. Melanisation of survival structures has several evolutionary advantages such as protection from UV radiation, successful penetration during infection, long-term survival, growth, and development [11,12]. Wilhelm [13] found the persistence of microsclerotia of *Verticillium*