Biofumigation and Solarization for Management of Soil-Borne Plant Pathogens

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PREFACE

Soil-borne plant pathogens include bacteria, fungi, nematodes, insects and weeds. Bacteria such as *Pseudomonas* and *Ralstonia* cause wilt disease in solanaceous vegetables and banana, and *Agrobacterium* cause crown galls in many plants. Fungi such as *Pythium* cause damping-off in vegetable nurseries, *Phytophthora* causes late blight, *Armillaria* and *Rhizoctonia* cause root rot, *Verticillium* and *Fusarium* are known to cause wilt. Nematodes such as *Meloidogyne* cause root-knot disease in vegetables, *Heterodera* and *Globodera* infect potato, *Pratylenchus* and *Radopholus* infect banana. Soil-borne plant pathogens also interact with other soil-borne pathogens and non-pathogens to trigger severe disease complexes. Control of soil-borne plant pathogens is a very difficult and challenging task.

One of the principal strategies used by the growers of high-value horticultural crops to combat these organisms is pre-plant soil disinfestation. Soil fumigants are the most effective disinfestation chemicals, and methyl bromide (MB) is the most important soil fumigant chemical used by growers around the world. It is a broad spectrum pesticide with excellent activity against most potential soil pests. However, MB was identified as a risk to the stratospheric ozone layer in 1992 and targeted for gradual phase out worldwide by 2010 by means of an international treaty, Montreal Protocol. The impending loss of MB as a soil fumigant has stimulated intensive efforts to develop and implement suitable replacement strategies. Among the alternative control methods being touted to replace methyl bromide are biofumigation and soil solarization that are among the most useful of the non-chemical disinfestation methods.

Biofumigation can be defined as the incorporation of biomass into soil, resulting in the release of toxic volatiles that reduce soil pests. Brassica cover crops may reduce or suppress some pathogens, including *Verticillium* in potato; *Pythium, Fusarium* and *Rhizoctonia* root rots in beans; *Pythium* in lettuce; pink root in onion; *Aphanomyces, Pythium, Rhizoctonia* and *Fusarium* root rot in peas; and cavity spot and *Fusarium* in carrot. Other benefits of biofumigation include: improved soil texture, increased water holding capacity, and improved soil microbial community structure. The Brassicaceae family is a source of potential biofumigation material. Family members contain secondary plant metabolites called glucosinolates, which are believed to be involved in plant defense. When tissues are damaged, glucosinolates are enzymatically broken down by

myrosinase to produce nitriles, thiocyanates, isothiocyanates and other products. Isothiocyanates, the predominant breakdown products, have biocidal activity on fungi, bacteria, nematodes and other pests.

Solarization is the use of clear polyethylene film to cover moistened soil and trap lethal amounts of heat from solar radiation. Solarization could be a useful soil disinfestation method, especially in areas with hot and arid conditions during the summer months. The pesticidal activity of solarization was found to stem from a combination of physical, chemical and biological effects. Soil solarization is effective against species of *Pythium, Phytophthora, Rhizoctonia, Fusarium, Verticillium, Ralstonia, Pseudomonas* and other soil-borne pathogens.

Biofumigation and solarization can also be integrated for the effective management of soil-borne plant pathogens.

The information on biofumigation and solarization for the management of soil-borne plant pathogens (bacteria, fungi, nematodes, insects and weeds) in horticultural (fruits, vegetables, plantation, spice, tuber, ornamental, medicinal and aromatic crops) and other crops (cotton, tobacco, wheat, rice, soybean, sugar beet and sunflower) is very much scattered. There is no book at present which comprehensively and exclusively deals with the above aspects on horticultural and other crops. The present book is divided into two parts. The first part deals with the principles of biofumigation and solarization. The second part deals with crop-wise management of soil-borne plant pathogens using biofumigation (crop rotation, cover cropping, intercropping, trap cropping, green manuring, etc.) and solarization (using transparent and coloured polythene sheets and live mulches) in horticultural and other crops. The book is illustrated with excellent quality photographs enhancing the quality of publication. The book is written in lucid style, easy to understand language along with adoptable recommendations for enhancing the productivity.

This book can serve as a practical guide to practicing farmers of horticultural crops. Further, it is a useful reference to policy makers, research and extension workers and students. The material can also be used for teaching post-graduate and under-graduate courses. Suggestions to improve the contents of the book are most welcome (E-mail: reddy_parvatha@yahoo.com). The publisher, Scientific Publishers (India), Jodhpur, deserves commendation for their professional contribution.

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