POTENTIAL OF BIOFUMIGATION FOR SOILBORNE PEST CONTROL IN STRAWBERRY

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Soil incorporation of Brassicaceae plant residues is a pest management approach utilized with the aim of attaining the release of allelochemicals that are biologically active, a phenomenon termed biofumigation (1). Brassicaceae residues contain glucosinolates that yield isothiocyanates (ITC), and other biologically active compounds, when hydrolyzed by the enzyme myrosinase. In addition to biofumigation, depending upon the target organism, pest control attained in response to *Brassica* residue amendments has been attributed to altered soil biology (2, 3, 4) at times acting through the modulation of host defense responses (5). Although the majority of studies have focused on use of *Brassica* green manures in the application of a biofumigant material, the use of seed meals, a by-product of the commercial food and industrial oil extraction process, is emerging as a more efficient and effective alternative application strategy.

Effective use of Brassicaceae seed meals for soil-borne pest control is dependent upon a variety of factors that vary with the operative mode of action. Efficacy of chemistry-based modes of action is contingent upon conversion of glucosinolates into biologically active compounds, a process that requires cell level tissue disruption. Thus, increased severity of tissue segmentation should enhance overall isothiocyanate yield and resulting level of pest suppression. However, as is the case for any pest control model, effectiveness ultimately will be determined by relative sensitivity of the target pest to the active mechanism. In certain plant production systems, failure of Brassicaceae seed meal soil amendment to provide effective disease control and enhance plant growth and yield was directly linked to resistance of target or non-target pests to active chemistries produced in response to this soil treatment (6). Knowledge of biological mechanisms operative in *Brassica* seed meal-induced pest control is imperative as application protocols will influence densities of the functional microbial community and thus the efficacy of these processes.

Studies were conducted to assess the capacity of Brassicaceae seed meals to suppress charcoal rot of strawberry caused by *Macrophomina phaseolina* and to determine the relative contribution of seed meal derived chemistry and soil biology in disease control. Seed meals were sourced from *Brassica juncea* (Oriental mustard), *Brassica napus* (Canola) and *Sinapis alba* (White mustard). Among these only *B. juncea* produces a biologically active volatile, allyl isothiocyante (AITC). Growth of *M. phaseolina* was suppressed when exposed to AITC, however AITC was fungistatic toward *M. phaseolina* and not fungicidal.

As AITC emission from treated soil is generally completed within 24 h after seed meal amendment, the specific chemical inhibitory effects of toward *M. phaseolina* are unlikely to function beyond this 24 hour time period. Irrespective of plant source all seed meal amendments suppressed strawberry root infection by *M. phaseolina*. However, the pathogen suppresssion observed in natural soil, was abolished when seed meal amended soils were pasteurized prior to infestation with *M. phaseolina*. In total these findings indicate that biological mechanisms contributed significantly to the disease control that was observed.

In small scale field trials *B. juncea* seed meal amendment suppressed artificially elevated populations of *M. phaseolina* but did not provide effective disease control. When trials were repeated a *B. juncea/S. alba* formulation, suppressed soil densities of the pathogen and significantly suppressed strawberry root infection. Across trials conducted in controlled and field environments there has been a lack of consistent association between the effect of seed meal amendment on *M. phaseolina* soil density and resulting level of root infection. This suggests that the observed disease control may have a greater dependence upon microbial interactions that transpired in the rhizosphere than that which occurs in the bulk soil environment. In these same trials, seed meal amendment provided effective initial (six week) weed suppression.

Successful application of *Brassica* seed meal-based 'bio-fumigant' strategies in plant production systems will require attention to the non-chemical, as well as chemical, processes that contribute to pest suppression. In addition, an understanding of the temporal differences in the operation of these mechanisms and the factors that limit or enhance their function will be instrumental to the effective use of this pest management practice. While such an approach would appear an implausible means to control the plethora of soil-borne pathogens affecting strawberry, the strategy when utilized independently (seed meal formulations) or as part of an integrated system has demonstrated effectiveness for the control of biologically complex diseases (6, 7).

References

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