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BRASSICAS: THE MOST POTENTIAL WARRIOR IN CONTROLLING SOIL PATHOGENS BY BIOFUMGATION

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Soil pathogens are very toughest micro-organism with huge diversity and very hard to control. Different chemicals used for controlling soil pathogens but their negative impact on the ecosystem and accumulation of chemical traces in the food chain through plant system is creating a great threat. As an alternative to chemical fumigation, Biofumigation has to become a new opportunity. It is mainly an agronomic practice, but it has an immense role as plant protector from different soil pathogen. The term 'biofumigation' was originally coined by J.A. Kirkegaard. Biofumigation is a mainly an agronomic practice that consists of the process of growing, macerating / incorporating certain with the interest of not only adding biomass and addition of organic nutrient by the decomposition but also suppression of soil pathogen by the use of released secondary metabolite that secreted by the plant cultivated as biofumigation. Mainly Brassica or related cruciferous species releases isothiocyanates compounds (ITCs) through the hydrolysis of glucosinolate (GSL) compounds contained in the plant tissues (Kirkegaard et al., 1993). Basically, Glucosinolatesare sulfur-containing carbohydrate compounds, whose degradation in the presence of the myrosinase enzyme releases substances that have biocidal properties and help limit the proliferation of certain pathogens. (Manici et al., 1997).

The mood of action and successful utilization of the bio fumigation

Plants such as broccoli, cauliflower, mustard, rapeseed, and horseradish contain organic compounds called glucosinolates. When the tissues of these plants are damaged, biologically active chemicals are produced as secondary metabolite. One of the most important compounds that are released is isothiocyanate (ITC). Generally, the pungency taste of mustard is caused by ITCs released when the tissues are macerated. At higher concentrations, ITCs are generally behaving as biocides that behave much like commercial pesticides. The isothiocyanate that is produced by mustard is called "Allyl isothiocyanate"

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(AITC). This AITC compound is very similar to the compound that is contained in the commercial fumigant like Vapam. The affect of AITC can be based on the allelopathic effect where the allelochemicals like AITC can suppress the growth of pathogens and can kill them. Morra and Kirkegarrd (2002) conducted experiments to determine the concentration and pattern of ITCs released from GSLs in Brassicaceous residues like rapeseed and Indian mustard. A rapid release of ITCs occurred immediately after tissue incorporation into the soil because cell membranes were broken during plough down. ITCs have a wide range of biocidal characteristics and are acutely toxic to a variety of pests and pathogens (Chew, 1987). Other than the direct biocidal effect these brassicas have some other indirect effect on soil pathogen control like

- Bio fumigant crops rotation can improve overall efficiency and productivity of the soil. The benefits of correctly incorporating biofumigant crops result in adding the well amount of organic matters that lead to improvements in soil health, plant health and a reduction in farm inputs cost.
- This Bio fumigant crops act as break crops between two susceptible host crop that disrupt the lifecycle of the different pathogen as they can kill the pathogens survival structure like sclerotia, spores and other hyphal and mycelial body *etc.*
- Suppression of pathogen can also be achieved by the changes in the soil fauna and microbial community of beneficial micro-organisms, including mycorrhizal fungi that have been found to increase after biofumigant crops.

Many Researchers has already studied about the successful inhibition of different pathogen by intercropping many crucifers plant, including brassicae. Some of them has been mentioned below:-

- *Aphanomyceseuteiches f. sp. Pisi* Causing Root rot of Pea (Muehlchen and Parke .1990).
- *Fusuriumoxysporum. f. sp. cumini*causing Wilt of Cumin (Israel *et al*. 2005)
- *F. o. f. sp. spinacia*causing Wilt of Spinach (Mowlick *et al*. 2013)
- *F. o. f. sp. niveum*causing Wilt of Watermelon (Njoroge *et al*. 2008)
- *Pythium ultimum*causing Damping-off of Tomato/pepper (Handiseni *et al.*2012)

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The factors related to effective biofumigation

The efficiency of *brassicae* as biofumigator plant depends on different factors. The ideal combination of all the factors leads to successful management of different soil pathogens. They are mainly-

1. Choosing of right plant sp. that have higher glucosinolate (GSL)like mustard has higher efficiency for biofumigation.

2. The crop identification as biofumigator should be based on the flexibility or adjustment of cultivation in the fellow period, they should be quick growing and need less attention.

3. The amount of glucosinolate in *brassicae* plant depends on the sulphur present on the soil. So, after testing sulphur should be used in soil with an adequate amount so that the production of glucosinolate should not be hampered.

4. Timing of incorporatrion of *brassicae* plant with soil is also an important factor. For maximum biofumigant activity, the plants need to be chopped and incorporated into moist soil when the tissue remains green. The glucosinolates are highest in the leaf tissue, but glucosinolate activity occurred in leaves and roots too. Plants should be chopped and incorporated in mid blooming stage for best glucosinolate production.

5. Soil moisture has immense role in rapid degradation of *brassica* residue and the release of ITC in soil.

Conclusion

There is also still a lack of information and practical knowledge on some of the agronomical practices *i.e* associated with growing biofumigant crops having maximum GSL production such as biofumigant crop selection, seed rate, proper fertilizer applications, sowing dates, incorporation with soil etc.So, there is a huge chance for researches to gather more and more knowledge regarding bio fumigants and its advantages and drawbacks if any. Moreover, the knowledge sharing and more and more practical implementation of knowledge can bring a biofumigant crop into the limelight and can also start an era that is far away of synthesized plant protection chemical and very close to mother nature.

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