Enhancing Plant Defense Mechanisms for Disease Management

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Use of chemicals and pesticides have degraded lands and water bodies all over the world. If we now find it essential to species survival to revert back to *wholistic* farming practices, it is imperative to understand what is happening within the plant system when it is subject to disease and other stress factors.

Emulating natural ecosystems and adapting them into our farming systems has been done over the years by our traditional farming practices. There is an amazing range of methods of biological control and use of botanicals to manage diseases in cropping systems.

At Mojo Plantation in Kodagu district, our story started with the cardamom stem borer (*Conogethes punctiferalis*). The larva of this moth bores into the succulent 'stem" of the cardamom plant, and feeds into the centre. It cocoons, the moth emerges, bores another hole, and flies out, to lay eggs in the canopy of the trees above or in the leaf litter below. One mother gives rise to 200 larvae, all of which move towards the cardamom plants like an epidemic! It follows a typical lepidopteran pest life cycle. In order to circumvent the damage to the cardamom crop, we developed some bioassays to screen a range of plants for their efficacy as pest repellents, and finally used the most common ones. These include:

Pongamia pinnata (karanj, Indian beech)

Annona reticulate (custard apple)

Ocimum tenuiflora (wild tulsi)

Vitex negundo (chaste tree, neergundi)

Lantana camara (lantana)

Nicotiana plumbaginifolia (wild tobacco)

Traditionally, there are many more plants which are like common weeds in India, which can be used for crop protection against insect pests:

Adathoda vasica (adulsa)

*Alpina galanga (*galanga)

Acorus calamus (vacha)

Crotolaria retusa (rattlepods)

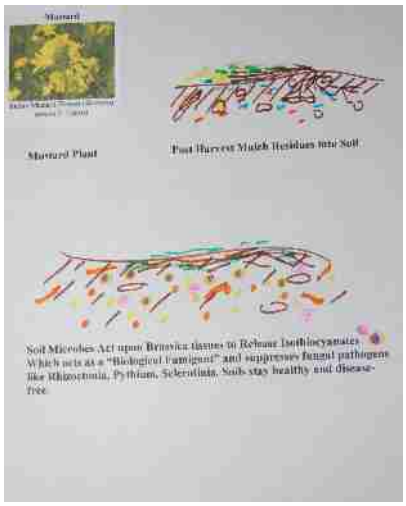
Calotropis procera (ak, milkweed)

Azadirachta indica (neem)

*Cassia fistula (*amaltas)

The list is endless! The leaves can be added to the soil to control soil pests or infusions made and used as foliar sprays.

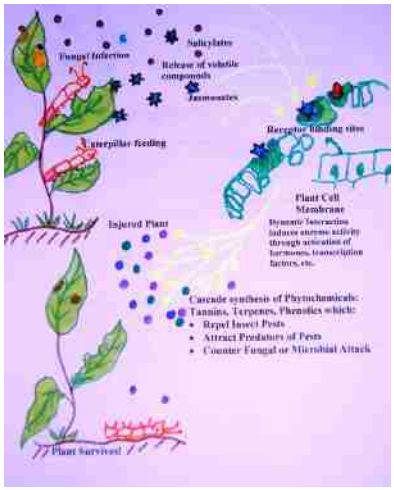
Several fungal diseases can be controlled by mustard and related plants. After harvest, if the plants are mulched into the soil, microbes act upon the sulphur containing peptides in the mustard plants to release isothiocyanates which act like a mild fumigant and suppress fungal growth. This provides an excellent protection to crops against infestations like *Rhizoctonia, Pythium,* and *Sclerotinia*. Phytopathogenic fungi like T*richoderma* are effective in controlling *Phytophthora* which causes root rots of several host plants, whereas *Bauveria bassiana* and *Verticilium leccani* have been used effectively against larvae of beetles and mealy bugs.



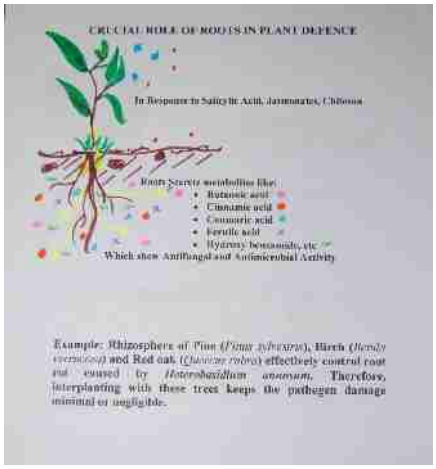
Cow urine and whey can be used as protective foliar sprays against a range of bacterial and fungal infestations, and wood ash is excellent for discouraging populations of aphids in vegetables.

However, through our years of growing crops in a fragile ecosystem, we now find that screening and selecting genetically resilient strains is a sound practice in disease management. Plants have developed a wide range of defense mechanisms to survive different stress factors including diseases. Resistance genes confer genetic protection. What is coming to be understood now is that susceptible species also stand a good chance of defending themselves through activating a series of metabolic pathways that allow a rapid expression of a broad set of defenses upon infection by a pathogen.

Injury triggers the release of volatile compounds like jasmonates and salicylates which bind to cell membrane-bound receptors to result in activation of a series of defense related enzymes. This results in the synthesis of compounds like terpenes, phenolics tannins, all that insects don't like.



Some plants also release compounds which attract predatory insects (spiders, wasps, dragonflies, etc) which control pest populations rather effectively. Even roots release a number of metabolites in response to elicitation by jasmonates, salicylates and chitosan which show antimicrobial activity. Rhizosphere of some trees have been shown to suppress pathogenic fungal communities.



With more and more information coming forth on induced defense mechanisms of plants, it is logical to create conditions where plants can fend for themselves. Growing crops organically enables the plants to develop and express their resistance pathway. Creating conditions within the agri-ecosystem to encourage biological diversity enables crops to be surrounded with balanced populations of predators (spiders, dragon flies, wasps, mantids, frogs, birds, shrews, etc) which help in disease management far more effectively than any spray.