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Role of Botanicals in Plant Disease Management

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SUMMARY

Plant disease epidemics threaten food security and income generation, especially in resource-poor countries and call for effective measures for their management. However, chemical control usually take a long time to degrade completely, which may cause heavy toxicity to human and domestic animals. Therefore, plant based pesticides appear to be one of the better alternatives for the control of plant diseases, as they are known to have minimal environmental problems and less danger to consumers in contrast to synthetic pesticides. So, research in natural biodegradable source of bio-fungicides is the need of the hour and efforts have been made by the researchers to control plant diseases using plant extracts.

INTRODUCTION

Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. Synthetic fungicides and insecticides are not eco-friendly for their potentially hazardous toxic effect. For the development of alternative control strategies to reduce dependency on synthetic fungicides, a number of botanicals have been tested against different plant diseases and insect pests for their management. Ahmed and Grainage (1982) identified many plant products, which were found to be effective for the control of many plant diseases. Among the 5280 plant species tested, 1134, 346, 92 and 90 plant species possessed insecticidal, fungicidal, antibacterial and antiviral properties, respectively. Wilkins and Board (1989) reported 1389 plants as potential sources of anti-microbial agents comprising of many different classes of compounds. Natural products from many plants are reported to control wide range of plant pathogens *viz*., fungal, bacterial and viral pathogens (Shekhawat and Prasad, 1971). The active compound that contain in botanicals can either inhibit the growth of pathogens or kill them and have no toxicity to the host cells are considered for developing new antimicrobial drugs (Nascimento *et al*., 2000). In general, the longer chain (C6–C10) molecules in plant extracts have been observed to have greater antifungal properties (Ultee *et al*., 2002). This article focuses on the exploration of botanicals in crop disease management and detailed information on their biologically active compounds responsible for their antimicrobial activity.

Botanicals used Against Different Plant Diseases

Sl. no.	Plants	Parts used	Preparation	Diseases/pathogen	References
1	Ginger (*Zingiber officinale* Rosc.)	Rhizome	Cold water extract	Aerial blight of soybean, *Rhizoctonia solani*	Ray and Kumar (2008)
2	Tulsi and Aonla extracts	Leaves	Cold water extract	Root rot and red blight in French bean, *R. solani*	Upmanyu and Gupta (2005)
3	*Lauris nobilis*	Leaves	Crude Extract	*Candida albicans* , *Aspergillus niger*	Erturk (2006)
4	Papaya and ipomoea	Leaves	Methanol extract	Anthracnose die-back of chilli, *C. capsici*	Ranasingh *et al.* (2011)
5	Allamanda	Leaves	Crude extract	Scab and die-back of citrus	Siddiquee *et al.* (2011)
6	*Lawsonia inermis*	Leaves	Crude Extract	*Drechslera oryzae*	Natarajan and Lalithakumari (1987)
7	*Aegle marmelos* and *Ocimum sanctum*	Leaves	Aqueous extracts	Blast disease of rice (*Pyricularia grisea*).	Tewari (1995)

8	*Allium sativum*	Bulbs	Crude Extract	*Alternaria alternata*	Karade and Sawant (1999)
9	Indian aloe (*Aloe barbadensis*) Neem , Tobacco	Leaves	Crude extract	Dry rot of yam, F. *oxysporum;* A. *nizer*	Taiga *et al*. (2009)
10	Turmeric, Ginger	Rhizome	Crude Extract	*Phytopthora infestans Pyricularia oryzae, Fusarium solani*	Bandara *et al*. (1989)

Bioactive Compounds from Botanicals Responsible for Antimicrobial Activity

The higher plants have been known for their medicinal properties since ancient times as it contain a wide spectrum of secondary substances having antimicrobial activity which apparently act as defence (against herbivores, microbes, viruses or competing plants) and signal compounds (to attract pollinating or seed dispersing animals), as well as protecting the plant from ultraviolet radiation and oxidants (Swain, 1977; Kutchan, 2001). Banso and Olutimayin (2001) have shown that plants are composed of a wide variety of active principles. The physiological/biochemical basis of resistance of plants to fungal and bacterial pathogens has been associated with both preformed and infection induced antimicrobial compounds. The grouping and characterization of secondary (antimicrobial) compounds present in the plant extracts *via* chromatogram techniques has resulted in the identification of active principles. Chromatographic techniques are commonly used to characterize such compounds and they have different properties against the plant pathogens. The mechanism of action of plant products on fungal cells is thought to be: (i) granulation of cytoplasm; (ii) membrane rupture in cytoplasm; (iii) inhibition and inactivation of intracellular and extracellular enzyme synthesis. These actions can occur in an isolated or in a concomitant manner and culminate with mycelium germination inhibition (Cowan, 1999). The antimicrobial activities of different plant extracts against plant disease have also been observed by several researchers under laboratory and field conditions (Suberu, 2004; Soylu *et al*., 2006). Plants that are rich in alkaloid, tannin, glycoside, saponin, flavonoid, terpenoid possess antimicrobial activity against a number of micro organisms (Adebajo *et al*., 1983; Nweze *et al*., 2004; Das *et al*., 2010). Phytochemical screening is very important in identifying and understanding of antimicrobial and new sources of therapeutically and industrially important compounds (Dubey *et al*., 2004; Akindele *et al*., 2007). To characterize the desired chemical compounds, the extraction of bioactive compounds without the loss of their properties is considered as the most significant step in the study of bioactive compounds.

CONCLUSION

Indiscriminate use of chemical pesticides leads to fungicide resistance, poor efficiency in certain areas and most particularly posses residual risk. Much research have been done using natural products from plants which are reported to control wide range of plant pathogens. But thousands of phytochemicals with potentials for inhibition of phytopathogens are yet to be explored to utilize and apply in large scale as plant protection measures. The ethno-botanical study of plants is a crucial topic applicable in plant disease management research and has become the need of the hour in modern day. Knowledge on the medicinal properties of plants with their proper methods of extraction and standardization is of utmost importance. Some handful of botanicals have been evaluated and applied in plant diseases management and thereby have paved a way for microbiologist, plant pathologist, pharmacologist to find a lead compound, a botanical to an exploitable product. Efforts should be made to establish collaboration between universities and local pharmaceutical companies to produce new commercial formulations from unexplored botanicals with scientific proof of safety, quality and efficacy are relevant to progress in this area.

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