

Application of Indigenous Technological Knowledge (ITK) for Plant Disease management in Tamil Nadu.

ABSTRACT

Most of the farmers in our country highly depending on the chemical pesticides and fungicides to control the pest and disease of agriculture and horticultural crops. Abundant usage of these pesticide in the crop fields causes harmful effects to human beings as well as to the other living organisms. Harmful effect of these chemicals brings the emergency call for ecofriendly and hazard free sustainable agriculture. Indigenous technological knowledge (ITK) originates from local, rural community and it can play an important role in organic agriculture. The ITKs are eco-friendly and compatible to various agricultural management practices particularly for pest and disease management. Application of ITK in crop management, contributing towards chemical residue-free agricultural products. The farmers of Tamil Nadu state in India profusely using the chemical pesticides and fungicides to control the crop pest and diseases even though most of districts of Tamil Nadu having its own ITK practices with respect to location specificity. Hence, an attempt has been made to document some of the significant and effective ITKs followed by the farmers in Tamil Nadu for management of crop diseases. This paper contains an overview of Indigenous Knowledge in Plant diseases management to help the researchers in the future.

Keywords: Botanicals, Indigenous technological knowledge, Panchakavya, Plant diseases

1. INTRODUCTION

The Indigenous Technical Knowledge (ITK) is the local knowledge that is unique to a given culture or society where its knowledge passes from generation to generation. It is the knowledge that people have gained through inheritance from their ancestors. Wang [1] defined ITK as “the sum total knowledge and practices which are based on peoples accumulated experiences in dealing with situations and problems in various aspects of life and such knowledge and practices are special to a particular culture.” ITK is stored in people's memories and activities, and is expressed in the form of stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language and taxonomy, agricultural practices, equipment, materials, plant species and animal breeds. ITK is shared and communicated orally, by specific examples and through culture. Indigenous agricultural practices are an unwritten body of knowledge. There is no systematic record to describe what they are, what they do and how they do what they do, how they can be changed, their operations, their boundaries and their applications. It is held in different brains, languages and skills in as many groups, cultures and environments as are available today. Hence, there is immense pressure on the people of India to collect, preserve, validate and adopt Indigenous agricultural practices so as to reduce dependence on external inputs, to reduce the cost of cultivation and to propagate eco-friendly agriculture [2]

ITKs are practical in nature and optimize local thinking in the field of agriculture, fisheries, health, livestock and forestry [3]. Agricultural scientists believed that ITKs can play a significant role in solving issues related to modern agriculture and environment [4]. The scientific community accepted that the

assessment of ITKs is an indispensable part of the introduction of new agricultural technology. It is recognized that the knowledge of farmers must be taken into account before any new technology is developed and disseminated. The integration of scientific and traditional knowledge would help to develop technologies which are need based, better problem solving, locally available, easily acceptable, cost effective, convincing and credible to the agricultural farmers. Recent scenario has aroused interest in indigenous technical knowledge (ITK). These ITKs are based on experiences which gathered momentum through generations and are being developed and improved through informal experimentation. Indigenous technology is used by the native inhabitants of a country or region and it constitutes an important part of its cultural heritage.

In India, the chemical pesticides are largely being used by the farmers to control different pests and diseases of crops. Some of the pesticides do pose a potential risk to human and other life forms and unwanted side effects to the environment. The world-wide deaths and chronic diseases due to pesticide poisoning is about one million per year [5]. These detrimental effects of chemical pesticides bring the urgent need of organic agriculture. Therefore, it is important to develop holistic methods of managing pests and diseases of agricultural crops to make it more eco-friendly, economically viable and socially acceptable for the farmers [6]. In recent years, the importance of organic agriculture has been recognized and emphasized in those areas especially which are rich in biodiversity such as north eastern region of India

Application of ITK in pest and disease management of different crops has been practiced since long time. The ITKs are eco-friendly and compatible to other management practices also. Since chemical pesticides do pose serious threat to the soil, environment, plant, animal and human health, scientists are constantly working on alternative methods of pest and disease control in agriculture. Few attempts have been made by different scientists to document ITKs followed by farmers of different localities for management of pest and diseases of crops. Some of these are discussed below.

2. MATERIALS AND METHODS

The traditional knowledge on the plant disease management was collected in various districts of Tamil Nadu through a personal interviews and focus group discussion. Karur, Tiruchirappalli, Villupuram, Thiruvarur, Thanjavur and Nilgris districts of Tamil Nadu were choosen for this study. A structured interview schedule for data collection was developed by the investigator to assess the traditional and Indigenous Technical Knowledge (ITK) practices in plant disease management in the selected districts of Tamil Nadu. The online literature search was also performed via Google Scholar, Science Direct and Scopus using combinations of the keywords for searching research articles, proceedings, newsletter, and reports with respect to scientific validation of the identified traditional practices. The villagers of the selected districts were approached and asked about the traditional practices on management of plant diseases. The information received from the villagers have been categorized in different sub-headings and presented in this article.

3. RESULTS AND DISCUSSION

3.1 Chillies leaf curl disease management using buttermilk

Leaf curl disease in chilli plant is caused mainly by *Chillies leaf curl virus* (ChiLCV) ChiLCV shows a widespread occurrence in most of the chilli (*Capsicum spp.*) growing regions. In Trichy district of Tamilnadu foliar spray of buttermilk is done in chillies for the management of leaf curl disease. The formulation, prepared in buttermilk, was tested against the plant virus and found effective. The use of buttermilk for its antimicrobial activity in humans and plants has been a traditional practice. Many milk proteins are known to have shown antiviral activity, by inhibiting reverse transcriptase enzyme of viruses. Buttermilk base alone could reduce virus concentration but was more effective when used in combination with Bacillus formulations [7].

3.2 Fungal disease management using neem seed kernal extract

Fungi constitute the largest number of plant pathogens and are responsible for a range of serious plant diseases. Most vegetable diseases are caused by fungi. In Trichy district of Tamilnadu NSKE (Neem Seed Kernal Extract) 25 kg neem seed kernel soaked in 500 litres of water for 8 hours. Spraying with 5% NSKE controlled rice sheath rot, Blackgram powdery mildew, green leaf hopper (vector of rty) at 2 sprays at 15 days interval. Neem Seed Kernal Extract has fungistatic and fungicidal effects against plant pathogenic fungi like *Alternaria solani*, *Curvularia lunata*, *Fusarium oxysporum*, *Helminthosporium* spp. and *Sclerotium rolfsii* (Natarajan, 2002)⁸. A range of fungal infections including *Candida albicans*, *Aspergillus fumigatus*, *Aspergillus flavus*, *Aspergillus niger*, *Microsporum gypseum*, *Microsporum canis*, *T. mentagrophytes*, *T. rubrum*, *Cladosporium* spp., *F. oxysporum*, *Penicillium notatum*, and *Penicillium citrinum* can also be treated using neem oil [8,9,10]

3.3 Seed borne diseases management using mint leaf extract

The seed-borne diseases such as leaf stripe, *Fusarium*, and loose smut are largely controlled by the use of certified seed and seed treatments. In Karur district of Tamilnadu mint leaf extract was prepared by soaking 100 g of mint leaves in one liter of water for one hour. Soaking seeds in mint leaves extract would prevent the seeds from seed borne diseases. Hafedhet *al.*, [11] conducted a study to investigate the efficiency of the combined effect of hot water leaf extracts of horse-mint (*menthe longifolia* L. Hands) against six pathogenic fungi associated with legume seeds: *Aschochta fabae*, *Macrophomina phaseolina*, *Alternaria alternata*, *Drechslera specifera*, *Fusarium solani* and *Curvularia lunata*. All tested concentrations of the leaf extracts were found reduced significantly mycelium growth and spore germination of pathogenic fungi associated with legume seeds. The concentrations of 20 and 30g/l were effective in suppressing radial growth of *A. alternate*, *A. fabae*, *M. phaseolina* and *F. solani*

3.4 Blast Management Using *Prosopis juliflora* Leaf Extract

The rice blast fungus attacks the crop at all stages of crop growth from seedling to late tillering and ear heading stage. The disease is favored by long periods of free moisture, high humidity, little or no wind at night, and night temperatures between 63 and 73°F. In Karur district of Tamilnadu 20Kg of *Prosopis* leaves were soaked in 200 litres of water to get 10% extract. This *Prosopis* extract is sprayed in paddy for management of paddy blast disease. *Prosopis juliflora* leaves and fruit extracts had their antimicrobial activities evaluated against the growth of selected bacteria and yeast, and against mycelial growth and conidial germination of selected mycotoxins-producing fungi. *P. juliflora* water-soluble leaf ethanolic extract with its novel extraction method showed the strongest antibacterial activity. Antimicrobial tests showed total inhibition of *Botrytis cinerea*, *Alternaria alternata*, *Bacillus subtilis*, *Staphylococcus aureus* and *Candida albicans*. Percent inhibition of mycelial growth of the extract was also determined against seven other fungal strains with highest value against *Geotrichum candidum* (66.2%). Even the least affected fungal strain showed alterations in their hyphae and spores exposed to extract when observed using scanning electron microscope (SEM) [12].

3.5 Management of bacterial and viral diseases using Papaya leaf extract

In Karur district of Tamilnadu 10Kg of papaya leaves soaked in 200 litres of water to get 10 % extract. Papaya leaf extract sprayed in all type of crops for the management of bacterial and viral diseases. Particularly, for the management of brown spot disease of rice, farmers used to prepare solution from 2 kg fresh leaves of papaya in 3-4 liters of water. That solution is need to be kept overnight. After that solution is filtered by using a cloth. Then, that is diluted in 50-60 liters of water. In that solution 250 ml of soap solution can be added as a sticker or surfactant [13,14]. The active compounds contained in seed extract and papaya leaves are flavonoids, alkaloids, tannins, steroids, and

saponins. Extracts isolated from papaya plants had gram-positive antibacterial activity greater than the gram-negative bacteria [15].

3.6 Antimicrobial activity of Herbal extract

Indiscriminate use of most of the synthetic fungicides has created different types of environmental and toxicological problems. Recently, in different parts of the world, attention has been paid towards exploitation of higher plant products as novel chemotherapeutants in plant protection. The popularity of botanical pesticides is once again increasing and some plant products are being used globally as green pesticides. In Thiruvavur district of Tamilnadu spraying of leaf extracts of different indigenous plants species viz., notchi, adathoda and datura sprayed in black gram and green gram as plant protection measure to protect the plant from pest and disease. *Vitex negundo* has strong inhibitory effect against *Rhizoctonia solani* and *Xanthomonas oryzae* under *in vitro* and *in vivo* [16].

Adathodavasica leaf extract significantly reduced the bacterial leaf blight pathogen, *X. oryzae* (Xoo) *in vitro*. Seed treatment was found to be effective in reducing the incidence of the disease under greenhouse condition. Physiological observation of *Adathodavasica* treated plants indicated that restriction of pathogen colonization or disease development in plant tissue was correlated with the pronounced increase of peroxidase, PAL, β -1, 3-glucanase polyphenol oxidase and phenol activity after challenge inoculation with the target pathogen [17]

Datura metel the member of Solanaceae family is famous due to its herbicidal, antibacterial & anti-fungal activity [18]. In *Datura metel* plant extract twelve phyto-constituents viz. eugenol, 2-pentadecanone 6,10,14 trimethyl, pentadecanoic acid, pentadecanoic acid, 1 4-methyl- methyl ester, phytol, 9,12,15-octadecatrienoic acid, heptacosane, *n*-hexadecanoic, 6-octadecanoic acid, 9, 12 octadecanoic acid, dodecanoic & tetradecanoic acids were identified. The presence of these bioactive constituents make *D. metel* as an effective antifungal agent against *R. solani*.

3.7 Pulses root rot management using Calotropis

Mungbean [*Vigna radiata* (L.) Wilczek] is an important pulse crop globally. This imperative crop is severely affected by charcoal rot disease caused by *Macrophominaphaseolina*. In Pudukottai district spraying of the leaf extract of *calotropis* against pulse crop disease management is practiced. The higher concentration of methanolic leaf extract of *Calotropis procera* (7%) caused maximum inhibition in the diameter of *M. phaseolina* i.e. 38%. The *n*-hexane fraction of methanolic leaf extract was found to be the most effective against *M. phaseolina*. Seven compounds belonging to classes of chlorocarbon, aromatic hydrocarbon, azo compounds, aromatic carboxylic acids and fatty acids were identified in GC-MS analysis of *n*-hexane fraction. Antifungal activity of the methanolic leaf extract of *C. procera* might be due to the presence of the identified compounds in *n*-hexane fraction of methanolic leaf extract.

3.8 Paddy khaira disease management using Tamarind extract

Khaira disease is a common disease in rice caused to zinc deficiency. It leads to the formation of dusty brown patches on leaves and causes necrosis. In Thanjavur district tamarind extract is used for the management of khaira disease. Five hundred g of tamarind leaf was chopped and homogenized in a mixer after adding 200 ml of water. The homogenate was initially filtered through a layer of muslin cloth. The final volume of the extract was made to 500 ml with water to form 100% extract. This extract was diluted to 10% concentration and sprayed over paddy leaf to check khaira disease.

Jacob et al [19] evaluated the influence of tamarind leaf extract (5, 10, 15, 25 and 50%) on the growth of certain polypathogenic fungi (*Phytophthora*, *Colletotrichum gleosporioides*, *Alternaria solani*, *Fusarium solani*, *Rhizoctonia bataticola*, *Sclerotium rolfsii*, *Pellicularia filamentosa* and *Macrophominaphaseolina*). Tamarind leaf extract suppressed the growth of all the fungi spp. at 3 days after inoculation. The tamarind leaf extract offers great opportunity for use as an antifungal botanical to control seed, soil and air borne phytopathogenic fungi.

3.9 Panchagavya for disease management

In Trichy district for Rice, Banana and vegetables Spraying of Panchakavya @ 3% without external chemical inputs is practiced for plant protection measures and to get higher yield. Panchagavya is mixture of eight products namely cow dung,urine,milk,ghee etc. It promotes plant growth, yield and immunity and it also an organic pesticide. It is mainly used in organic farming. Panchagavya contains a significant proportion of macronutrients like Nitrogen, Phosphorus and Potassium as well as micronutrients like Zinc, Magnesium, Calcium, Copper, Manganese that are required for the growth and development of plants.Hence Panchagavya boost immunity and promote plant growth. *Panchgavya* in agricultural fields dramatically influences the growth and crop yield by promoting the beneficial soil microorganisms around the roots [20]

There is a wide scope to find the spectrum of panchagavya in inhibiting the several soil borne and seed borne fungal plant pathogens. The previous research provides evidence about panchagavya as soil fertility agent, insect repellent and plant growth promoting agent. These distinguished features of panchagavya can make itself best suitable for integrated pest, disease management and integrated nutrient management program.

4. CONCLUSION

It is concluded that our farming society in Tamil Nadu, which is going through a transition phase that gradually adopting the ways and means of traditional disease management for sustainable agriculture. It has been proven that the various diseases can be controlled by using the natural products with different formulations. Adoption of ITK based crop protection measures as an alternative to chemical fungicides might help in avoiding the residual effect as well as restoring the biodiversity of natural enemies. Tamil Nadu is experiencing the revival of traditional and indigenous practices in agriculture and allied activities. Hence, it is the right time to disseminate good agricultural practices that are rich in ancient wisdom and also proper coalition between the traditional and modern knowledge and technology system has vast potential for benefit of the farming community.

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