

## Short Communication

# Plant Protection Practices in India Based on Indigenous Knowledge\*

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## Abstract

Ancient Indian texts such as Varahamihira's '*BrihathSamhitha*', Chavundaraya's '*Lokopakara*' and Sarangadhara's '*SarangadharaSamhitha*', provide recommendations for an integrated approach to control crop pests and diseases by managing soil, seed, plant and environment. The seed treatment with cow dung, milk, juice of plants and cow ghee is also prescribed. As prophylactic measure for disease control, the incense of plant leaves and flowers, along with fish meat, turmeric, mustard, are mentioned. '*Panchagavya*' to control plant diseases were found effective in managing soil-borne diseases of tomato and Panama wilt disease banana.

**Keywords:** Diseases, Indigenous Knowledge, *Kunapajala*, *Panchagavya*, Plant Protection, Pests, *Vrikshayurveda*

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## 1. Introduction

India has a treasure of indigenous knowledge concerning plant health developed and documented several centuries ago. The three major ancient texts *interalia* are: (i) Varahamihira's (505 CE) *Brihat-Samhita*, Part I *Vriksshayurveda*<sup>1</sup>, (ii) Chavundaraya's

(1025 CE) *Lokopakara* Chapter 6 *Vriksshayurveda*<sup>2</sup>; and (iii) Sarangadhara's (1363 CE) *Vrikshayurveda*<sup>3</sup>.

It is, however, to be noted that this knowledge was developed in the pest-disease scenario prevalent 10 to 15 centuries ago, during which time many of the current pests and diseases may not have

\*This is unabridged version of the paper presented at the symposium on "Indigenous knowledge systems" at the 13th International Plant Protection Congress, 2-7 July, 1995, The Hague, The Netherlands. The information provided pertains to pre-1995 period. Species names with (?) indicate that authors were not sure of the current names.

*Nevertheless, these methods have common characteristics such as (i) multi-pronged attack on the pest and disease, (ii) improving the plant health thereby increasing the resistance capability, (iii) enriching soil with nutrients and increasing useful microbial activity, and (iv) broad-spectrum effect on pests and diseases, which are desirable.*

existed. Nevertheless, these methods have common characteristics such as (i) multi-pronged attack on the pest and disease, (ii) improving the plant health thereby increasing the resistance capability, (iii) enriching soil with nutrients and increasing useful microbial activity, and (iv) broad-spectrum effect on pests and diseases, which are desirable. We should not overemphasize the role of indigenous knowledge, as we explore the complementary interactions between the indigenous and contemporary knowledge systems. In this paper we present: a) A few indigenous methods of plant protection as outlined in ancient texts, b) The documentation of research endeavors in a few indigenous plant protection practices in the University of Agricultural Sciences, Bangalore (UASB), India, c) The documentation of indigenous methods of plant protection as practiced by a few farmers, and d) Policy implications.

## 2. A Few Indigenous Methods of Plant Protection as Outlined in Ancient Texts

Authors of the ancient texts mention of the painstaking efforts while observing and researching on the indigenous methods they have documented.

### 2.1 Seed Treatment

#### 2.1.1 The Following Methods are drawn from Chavundaraya's Lokopakara

Only those seeds from fruit-bearing trees, which have fallen on their own, need to be considered for

planting. Seeds are mixed with cow dung and dried for five days; dipped in milk for five days; dipped in water for five days; treated with the mixture of tender coconut water and fruit juice of eggplant (*Gulla*) (*Solanum ferox*); further treated with the incense of the cow ghee + false black pepper (*Embelia ribes*); and finally treated seeds are sprinkled with fresh water before sowing. These steps promote good germination and sprouting in seeds.

#### 2.1.2 The Following Methods are drawn from Varahamihira's BrihatSamhitha

The seeds need to be soaked in cow milk for 10 days. Every day they have to be taken out with palms greased with cow ghee. Later they are rolled in cow dung mixed with flesh of deer and hog. Later on they are treated with the flesh and marrow of hog. Treated seeds are planted in the soil. The sown seeds are to be sprinkled with milk and water.

### 2.2 Pest Avoidance

A mixture of asafetida (*Ferula asafetida*), sweet flag (*Acorus calamus*), black pepper (*Piper nigrum*), false black pepper, seeds of cashew nut (*Anacardium occidentale*), and *Barleria busivolvia* or *Chelianthes farinosa*, black mustard (*Brassica nigra*) and the cow horn pepper (*Capsicum annum*) with cow's urine applied to the plant roots provides comprehensive avoidance of pests.

### 2.3 Disease Avoidance

The incense of false black pepper, Guggul (*Commiphora wightii*), fish meat, turmeric (*Curcuma longa*), black mustard seeds, flowers of Indian laurel (*Terminalia tomentosa*) provide protection to plants against diseases. If the growing tips of plants dry up or get broken or get whitened, such plants are inferred to have been affected by disease. In the affected part, warm ghee has to be smeared and black soil applied to enable plant to combat the disease. As

per *BrihatSamhita*, the ulcers in the affected trees are removed with knife. A paste made using false black pepper, cow's ghee, and silt is applied to the affected parts and later sprinkled with water and milk.

According to *Sarangadhara*, the pathological conditions of wind (*vata*), bile (*pitta*) and phlegm (*kapha*) which are responsible for diseases in human beings are also the causes of diseases in plants. When trees are affected by pests, the affected parts should be removed. The disease due to *vata* are overcome with the application of clarified butter and flesh juice; that due to *pitta* is overcome with the application of substances that are cold mixed with water; and that due to *kapha* are overcome with the application of substances which are acidic and mixed with hot water or substances which are pungent and bitter. In addition, plants which have tubercles all over the body due to *Vata*, can be treated with the application of lodhra (*Symplocos racemose*) flowers, cow dung, fats and *kunapa* water. The *kunapa* water (*Kunapajala*) is prepared by boiling flesh, fat and marrow of deer, pig, fish, sheep, goat and rhinoceros in water. The boiled water is mixed with milk and powders of sesame, oil cake, and pulses boiled in honey, the pulse decoction, clarified butter and hot water in an earthen pot, and kept in warm place for a fortnight (for fermentation) and the resultant compound is *Kunapajala*.

Trees which are attacked by any type of pests, are to be treated with the paste made from bark of Pongamia (*Pongamia glabra*), Golden rain tree (*Cassia fistula*), Soap nut (*Sapindus laurifolius*), Devil tree (*Alstonia scholaris*), false black pepper and Tiger nut (*Cyperus*

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*esculentus*) in cow's urine. Exudation from trees can be stopped with the application of the paste of foxtail millet (*Setaria italica*) and bark of Arjuna tree (*Terminalia arjuna*) in boiled milk.

### 3. Research on Indigenous Plant Protection Practices at the University of Agricultural Sciences, Bangalore (UASB), India

In general, it is difficult to manage soil-borne diseases by any means, including cultural control, especially *Fusarium* spp., since it can remain viable in soil for almost 50 years. Plant pathologists at UASB used different combinations of '*Panchagavya*' for control of seedling disease and wilt in tomato caused by *Fusarium oxysporum* f. sp. *lycopersici* and for the control of Panama disease of banana caused by *Fusarium oxysporum* f. sp. *cubense*.

#### 3.1 *Panchagavya* to Control Seedling Diseases and Wilt in Tomato

The study was conducted in laboratory, glasshouse, nethouse and in the field during 1992-93.

Tomato cultivar "Pusa Ruby" was used as test plant. The seedlings were raised in cement pots filled with wilt-sick soil. The traditional *Panchagavya* was modified by adding yeast and common salt and three formulations of were tested. The components of modified *Panchagavya* (MPG) were fermented for 7 to 10 days in closed plastic container and stirred every day for 10 minutes. The addition of salt is to reflect Jim Martin's living water concept promoting microbial activity which is further augmented with the addition of yeast.

The fermented preparation was diluted 10 times with water and filtered through two layers of muslin cloth to obtain a clear filtrate. The filtrate was used for dipping seedlings for 30 minutes and for drenching

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the sick soil pre-infected by the pathogen in the experiments. Three MPG combinations (MPG-1, MPG-2 and MPG-3) were tested of which the third formulation MPG-3 was the most effective in reducing disease at seedling stage under field conditions. Further, four dilutions of MPG-3 (0, 10, 100, 1000 parts of water) were tried. The lowest disease incidence was in zero dilution. There was delayed appearance of wilt symptoms by 2 to 10 days in all the treatments over control.

A field experiment was conducted with neem cake, MPG-3 (10× dilution, as above), Carbendazim (0.1%), Neem cake (NC) + MPG-3, inoculated control, un-inoculated control and other combinations (Table 1).

The MPG-3 and Neem cake (NC) + MPG-3 treatment had maximum disease reduction under both pot culture and field conditions. Neem cake (NC) + MPG-3 gave the highest fruit yield compared to MPG-3 and Carbendazim alone. The cost benefit ratio was most favorable with MPG-3. It is important to note that

**Table 1.** *Fusarium* wilt control under different combination treatments in tomato

| Treatment             | Disease incidence (%) | Fruit yield tonnes/ha | Cost: benefit ratio |
|-----------------------|-----------------------|-----------------------|---------------------|
| Un-inoculated control | -                     | 14.1                  | -                   |
| Carbendazim*          | 34.4                  | 10.3                  | 1:4                 |
| Neem cake**           | 25.0                  | 11.6                  | 1:1.1               |
| MPG-3***              | 20.3                  | 12.3                  | 1:2.1               |
| NC+MPG-3              | 7.8                   | 16.7                  | 1:2.4               |
| Inoculated control    | 55.7                  | 7.7                   | -                   |

Note: \* Carbendazim at 0.1%; \*\*Neem cake @ 2.5t/ha;

\*\*\*MPG-3 at 1:10 dilution.

each single component of *Panchagavya* when applied to the sick soil individually was not effective against *Fusarium*. For instance, the fresh liquified dung + urine when sprayed without dilution had phytotoxic effect, but when all the five components of MPG-3 were combined and fermented for 10 to 14 days, no phytotoxic effect on tomato foliage was observed.

### 3.2 'Panchagavya' to control Panama wilt of Banana

The Panama wilt is one of the most catastrophic plant diseases of banana in the world. Experiments with *Panchagavya* were conducted to explore the possibility of controlling the Panama disease in banana in cultivar "Nanjangud rasabale" during 1992-94.

As outlined earlier, the MPG-3 was used as seedling dip and soil drenching. Carbendazim was applied @ 1g/L as seedling dip (one hour) and 0.1% as soil drench on the day of planting. Healthy banana suckers developed by tissue culture were dipped in MPG-3 for 2 hours and planted in the sick soil.

The different treatments under pot culture studies were *Trichoderma viride*, *Pseudomonas fluorescens* (1 hour dip, 10<sup>8</sup> cells/ml), *Bacillus subtilis* (1 hour dip, 10<sup>6</sup>/ ml), MPG-3 (2 hour dip, @10× dilution), carbendazim (0.1 %) and inoculated control with *Fusarium* and un-inoculated control. MPG-3 treatment provided encouraging results in pot culture on par with biocontrol and chemical control agents. Soil application of MPG-3 provided encouraging results compared with seedling dip. The population of *Fusarium* declined significantly after 150 days of planting. These results indicate the promise of MPG-3 as eco-friendly and cost effective management of the *Fusarium* wilt.

### 3.3 Studies on Pest Control

The insecticidal properties of 45 species of plants in Mysore (Karnataka State, India) on four caterpillars

(*Plutellama culipennis*, *Euproctis fraterna*, *Prodenia litura*, *Crocidolomia binotalis*); surface grasshopper (*Epacromia tumulus*); and soft scales (green bug) (*Coccus viridiscolemani*) are reported in literature. The seeds of white hoary pea (*Tephrosia candida*) and custard apple (*Annona squamosa*), bark of cork brush (*Mundulea suberosa*) possessed high degree of insecticidal potency. For getting spray emulsions, the hot industrial alcohol extracts of Cork brush bark and white hoary pea seeds have to be mixed with molasses and diluted with water.

#### 4. Documentation of Indigenous Methods of Plant Protection Practiced by Farmers

The leaves of balsam tree (*Lasiosiphon eriocephalus*), Strychnine tree *Strychnos nux-vomica*, neem (*Azadirachta indica*), American aloe (*Agave americana*) are used on any pest or disease affected plant. The preparation consists of 1kg of any of the above leaves in a bucket, added with 10 L of boiling water and kept for 24 hours to ferment in the sun. The solution is decanted and is ready for spray at 1:10 dilution. In order to control fungal and viral diseases, the leaves of sweet flag (*Acorus calamus*) can be used similarly as above. For the control of bacterial or viral attack of roots of coffee and cinnamon trees, the leaves of stinging nettle (*Tragia involucrata*) are similarly used. In addition, farmers

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listed the leaves of cashew nut, custard apple, crown flower or giant milkweed (*Calotropis gigantean*), *Pongamia glabra*, betel leaf (*Piper betle*), Lantana (*Lantana tiliaefolia*), sweet flag and elephant yam (*Amorphophallus campanulatus*) can be used for pest control. These practices, however, need to further experimentation.

#### 5. Summary

Ancient Indian texts such as Varahamihira's 'Brihatsamhitha' (5<sup>th</sup> Century CE), Chavundaraya's 'Lokopakara' (9<sup>th</sup> Century CE), and Sarangadhara's 'Vriksayurveda' of (13<sup>th</sup> Century CE) provide recommendations for the plant protection practices based on indigenous knowledge. Treatment with 'Panchagavya' was found to most effectively control the Fusarium wilt in tomato under pot culture and field conditions. This modified 'Panchagavya' formulation effectively controlled the Panama disease of banana for the initial three months. It is heartening to note that plant protection experts are evincing keen interest in the indigenous methods of plant protection. However, research endeavors need to be oriented towards validation of the indigenous methods. This calls for funding support for research on the efficacy and complementarity between indigenous and modern methods of plant protection especially in tropical developing countries.

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