

Traditional Agricultural Practices for Crop Protection – Testing and Validation

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Abstract

The increase in the use of pesticides in the past two decades has led to several problems such as environmental degradation, health hazards for humans, pest resistance and resurgence and decrease in the population of beneficial insects, which has a direct impact on pest management. In ancient days, farmers used fruits, leaves and the bark and roots of various plants like neem, pongam etc. for pest and disease management. The Vrksbayurvedic texts provide information on various traditional pest management practices that involve mechanical, agronomical and biological methods.

Our studies on and experience of traditional plant protection are presented here. We show the contemporary relevance of certain folk practices. The Ayurvedic approach was followed in the preparation of biopesticides such as arkam, kashayam, asavam, thailam, arishtam etc. from plants. Experiments were conducted both in the laboratory and in the fields on different crops to test the efficacy, dosage and shelf-life of biopesticides. Fumigation was an age old practice for disease management in crops. We have tested the same using different plant products and have obtained promising results. This paper presents our experiences on the application of Vrksbayurvedic principles to present day problems in agriculture.

In ancient days and prior to the Green Revolution, farmers in rural areas were practising a wide range of traditional techniques for pest and disease control. Some practices were supplemented with religious ceremonies and rituals. A few examples are given below.

- The festival *Karthigai Deepam* is celebrated during the months of November–December wherein there is community lighting of lamps during the evening hours. This serves as a bonfire for the pests that attack the samba crop (sown in Aug–Sept) that will be at its peak vegetative phase during this period (Nov–Dec) and is highly prone to pest attack.
- *Mulaipaari* (germination test) is done in the month of *Adi* (July). People in the villages take a handful of seeds of the different varieties of crops that they are interested in sowing that particular season and place them in a pot for germination. This is left in a temple for four to seven days after which the pot is carried round the temple. The seeds that have germinated better are chosen for sowing in the following season. This serves as a germination test for different seeds.
- *Pon yeru kattuthal* is done on the first day of *Chitirai* (which usually falls on April 14th). The *yeru* (plough) is worshipped, decorated and taken to the field where the first ploughing is done. This incidentally falls during the peak of summer, and this summer ploughing brings the resting stages of pests like pupa to the surface

where they are destroyed either by the hot sun or are picked up by predatory birds.

Many such practices are on the verge of extinction owing to the Green Revolution and the quest for increasing food production to meet the demands of the growing population.

However, these traditional methods are simple, cost effective, eco-friendly and can easily be adopted by farmers. They can be broadly grouped as under:

1. **Mechanical methods** involve the mechanical removal of pests. For example, hand-picking the larvae and grubs, removing eggs from the tips of the leaves by pinching off the terminal portion, warding off birds that damage grains using effigies or by producing noise using drums, controlling pests by dusting ash on the plants etc.
2. **Agronomical methods** include various methods like intercropping, trap cropping, border cropping, crop rotation, fumigation, use of light traps, use of bird perches etc.
3. **Biological methods** involve the use of parasites, predators, botanical pesticides etc. for crop protection.

Traditional technologies – a few examples

1. Use of bonfire (light trap)

Light traps can be used to monitor and trap adult pests thereby reducing their population. Some common forms of light traps used are bonfires (traditional method), electric bulbs and hurricane lamps. A large plate or vessel containing kerosene mixed with water is placed near the light. The light trap should be 2–3 feet above the crop canopy. The trap should be set up in the field between 6–9 pm. After 9 pm., there are chances of beneficial insects getting trapped. Adult moths, which are attracted by the bright light, fall into this water and die.

2. Bird perch

The bird perch method involves the use of certain structures that invite birds to the fields when the larval population is high. ‘T’-shaped bird perches can be erected in the field at the rate of 15–20 per acre. Turmeric powder mixed with rice can also be placed on the perches to attract the birds. They should be one feet above the crop canopy. These perches serve as resting places for the birds that feed upon the larvae in the fields.

3. Intercrops/trap crops/border crop

A suitable crop that will act as a trap or susceptible host should be planted along with the main crop. This crop will invite the pests and thereby the main crop can be saved to a great extent from pest infestation.

4. Fumigation

Fumigation is the traditional method in which the smoke from certain natural products is used to control diseases especially in vegetable crops and to ward off pests in storage godowns. Fumigation is the process of application of a gas, vapour or

smoke to seeds and plants for the purpose of disinfecting or destroying pests. Generally, fumigation is done in storage areas and also in the fields. Sweet flag (*Acorus calamus*), vaividangam (*Embelia ribes*) and turmeric (*Curcuma longa*) are a few of the natural products commonly used for fumigation.

Fumigation experiment: Effect of fumigation using vacha and vaividanga on tomato seeds

Materials: The materials used were vacha (*Acorus calamus*) and vaividanga (*Embelia ribes*) on potted tomato plants.

Methodology: The seeds were soaked in milk and dried in the shade, and some seeds were fumigated (i) with vacha alone, (ii) with vayvindanga alone or (iii) with both and (iv) one set of seeds was maintained without any fumigation. The above four treatments were repeated on seeds that had not been soaked in milk. Parameters like number of seedlings, root length, shoot length and chlorophyll content were recorded.

Results: Soaking the seeds in milk and fumigating them with vacha increased their germination rate, and they also showed resistance to fusarial wilt.

Note: The above experiment was carried out by B.Sc. (Botany) students of Stella Maris College, Chennai.

Fumigating apparatus

CIKS has designed a fumigating apparatus for its experimental work. It has the dimensions 3' × 2' × 2' and is made of iron, with two sieves fitted at 10 and 20 cm from the top, to hold the seeds. It is fitted with hollow perforated pipes through which the fumes enter. It has a blower, heater and a fumigator. The blower is hand operated and used to blow air to the heater. The heater is used for producing fumes using the fumigants. The fumigator is a bin-like structure in which the seeds for fumigation are placed.

5. Use of botanicals or biopesticides – a few examples

Neem kernel extract

One acre of land requires 3–5 kg of neem kernels. The outer seed coat should be removed before use. The kernels should be pounded gently and placed in an earthen pot to which 10 litres of water should be added. The mouth of the pot should be tied with a cloth, and the pot should be kept aside for three days and then the contents should be filtered. On filtering, 6–7 litres of extract can be obtained. The shelf-life of this is about one month. Three to eight month old seeds should be used.

Neem cake extract

One acre of land requires 5 kg of neem cake. The neem cake should be powdered well and placed in a cotton cloth and tied. This should be immersed in a vessel containing 10 litres of water for three days. Later, the pouch should be squeezed well into the water. About 7–8 litres of extract can be obtained.

Note: One litre of the above extracts should be used in a tank with a 10-litre capacity, i.e., it should be diluted with 9 litres of water before spraying. Khadi soap solution (@ 100 ml/tank) should be added to help the extract stick well to the leaf surface. The concentration of the extract can be increased or decreased depending on the intensity of pest attack.

Examples of plants used as biopesticides

<i>Common name</i>	<i>Scientific name</i>
Adhatoda	<i>Adhatoda zeylanica</i>
Asafoetida	<i>Ferula asafoetida</i>
Chilli	<i>Capsicum annum</i>
Sida	<i>Sida acuta</i>
Garlic	<i>Allium sativum</i>
Ginger	<i>Zingiber officinale</i>
Milk weed	<i>Calotropis gigantean</i>

Table 1. Examples of a few promising biopesticides

Name of the preparation	Crops tested	Effective against
<i>Adhatoda, pudhina, triphala kashayam</i>	Paddy, vegetables	Leaf folder, bacterial leaf blight, Helminthosporium leaf spot
<i>Andrographis and sida kashayam</i>	Vegetables	Aphids and borers in brinjal and okra
Barley, sesamum, horse gram <i>kashayam</i>	Vegetables	Acts as a yield enhancer
Cow's urine and sweet flag <i>arkam</i>	Paddy, okra, chillies	Bacterial leaf blight, Helminthosporium leaf spot, vein clearing, fusarial wilt, ripe rot
Garlic <i>arkam</i> ,	Paddy	Leaf folder, bacterial leaf blight, Helminthosporium leaf spot
Panchagavyam	All crops	Growth promoter and provides resistance against diseases
Need seed extract	All crops	Leaf folder, aphids, jassids, fruit borer and stem borer

Five leaf extract	All crops	Jassids and borers
Ginger, garlic, chilli extract	All crops	Hoppers and borers

Advantages of storage forms of biopesticides

- Availability of raw materials is seasonal
- Raw materials are not available in all geographic locations
- Products are readily available and user friendly

Ayurvedic preparations

The biopesticides were prepared on the basis of our research, using the Ayurvedic approach. *Kashayam* (water extract) and *arkam* (distillate) are widely used for research currently. Preparations like *thailam*, *ksharam* and *phandam* are also under trial.

Advantages of the Ayurvedic approach

Biopesticides are prepared using traditional medical technology, and they have the following advantages.

- They are low cost preparations and require less investment.
- They do not cause any form of pollution.
- Neither high temperatures nor corrosive solvents are required during preparation.
- The technology for the preparation of *kashayam*, *thailam* and *arishtam* is widely known in India.
- They have a good shelf-life.
- The preparation process does not need any expensive equipment nor does it involve complicated technology.

Shelf-life of some Ayurvedic formulations

<i>Swarasam</i>	-	3–4 hours
<i>Kashayam</i>	-	24 hours
<i>Arkam</i>	-	1–4 years
<i>Asavam</i>	-	3–4 years
<i>Arishtam</i>	-	3–4 years
<i>Thailam</i>	-	6 months to 3 years
<i>Ksharam</i>	-	several years

Preparation of storage forms as per the Ayurvedic approach

We have tested out the preparation of the following forms, namely, *kashayam*, *arkam*, *phandam*, *asavam*, *arishtam*, *thailam* and *ksbaram*. *Kashayams* can be prepared in a concentrated form and their shelf-life can be increased to at least three months using 1% sodium benzoate, which is a food grade preservative used in the Ayurvedic drug industry. *Asavas* and *arishtas* are preparations that take a long time to prepare since there is a fermentation period of about 40 days. *Thailams* cannot be used at higher concentrations since the oil is not miscible with water. *Arkams* and *kashayams* are currently being used in various trials. Experiments with *ksbarams* have just commenced.

Comparative costs

Biopesticides are cost effective and eco-friendly. For example, to control bacterial leaf spot, leaf folder and leaf blight in paddy, the cost of chemical treatment (for 1 acre) using Monocrotophos, Endosulphan, Ekalux, Malathion and Bavistin is Rs.1,575. The cost of control using the above biopesticides is given below:

- Neem kernel extract - Rs.300 (10 litres)
- Five leaf extract - Rs.300 (10 litres)
- Chilli ginger garlic extract - Rs.350 (10 litres)
- Total cost - Rs.950

Difference = Rs.1575 - 950 = Rs.625 (includes the cost of raw material, fuel and labour).

6. Use of Panchagavyam

Panchagavyam is a plant growth regulator that in recent days is becoming popular among farmers. It is a combination of five products obtained from the cow and is extensively used in traditional medicine. The materials include dung, urine, milk, curd and ghee. It has been experimented on by CIKS, and farmers' experiences have also been documented. It plays a significant role in providing resistance against disease and pests and in increasing overall yield.

Conclusion

These age old techniques that have evolved through generations are very precious and should be protected from extinction. They are safe for the environment and the community. Considering their importance and immense potential, further research and validation becomes highly essential at this point. Research institutions and NGOs have a major role to play in reviving these techniques and putting them back in place among the farming community.