

Traditional pest control: A retrospection

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The paper reviews scope and utility of traditional pest control knowledge for the present situation arising due to hazards and ill-effects of chemical pesticides in agriculture. From a vast collection of pest control techniques used for generations by the rural farmers, packages of 'Traditional Pest Management' (TPM) are introduced for crops like rice, brinjal, *bhendi* and tomato.

Key words: Traditional pest control

The ill effects of the synthetic pesticides are scaling up day by day. The pest problems continue to persist and the human tragedies do occur periodically in various parts of the country. As an answer to this imbroglio, the traditional knowledge left behind by our predecessors appears promising in conjunction with the modern developments which have resulted in availability of various biological preparations particularly microbial pesticides and insect secretions as pheromones. Our fore-fathers have used varieties of plant-based products, crop residues like husk, shell, ash, animal products like cow urine, cow dung, milk, and minerals like red earth, sand etc. (Table 1) for protection and nutrition of crop plants. Most of these materials, which are safe, biodegradable, less persistent and easily available in and

around the farmers' lands, are the focus of attention today. The indigenous practices involving these products were carefully planned and have application value even today. Such treasures existing in the remote villages and tribal tracts are set to vanish from us due to organised urbanisation and unlimited ambitions of man.

In the light of the above, there is an awakening to promote such traditional technologies in crop production in various countries including India. To cope-up with this, efforts to document and revitalize the age-old agricultural practices of pest control are on the rise. It is in this background, the present paper reviews the status of indigenous pest control and presents the packages of pest control practices for crops like rice and certain vegetables.

Table 1—Biologicals, minerals and other materials used in traditional pest control

| | |
|---------------------|----------------------|
| 1. Rice flour | 15 Calcium carbonate |
| 2. Charcoal | 16 Tamarind seed |
| 3. Kitchen ash | 17 Asafoetida |
| 4. Goat hair | 18 Saw dust |
| 5. Tender coconut | 19 River sand |
| 6. Groundnut | 20 Copper sulphate |
| 7. Clay | 21 Kerosene |
| 8. Ragi husk | 22 Ox horn |
| 9. Rice husk | 23 Cow dung |
| 10. Chicken excreta | 24 Cow urine |
| 11. Sugar | 25 Fish oil |
| 12. Common salt | 26 Butter milk |
| 13. Coconut | 27 Mercury |
| 14. Red earth | |

Baskaran & Narayanasamy¹¹¹

Historical perspectives of indigenous pest control

Pest control practices of our ancestors are evident from protohistoric, historic and Vedic periods. Storage of grains in cylindrical pits dug in earth or in granaries or containers made of ropes and plastered with mud or in well-baked clay pots, scaring away birds by sling balls, initiation of mixed-cropping technique, controlled use of water in irrigation of fields etc are some of the practices found in use during these periods.¹

During Vedic era, cultivators kept away birds from cornfields by making din and noise and setting traps or digging pit falls and fix traps in the field to drive away the wild animals. Seed treatment with cow dung, milky juice of *Solanum*

Table 2—Pest control plants of Vedic era

| Sl. No. | Common name | Scientific name |
|---------|-------------------|-----------------------------------|
| 1. | Ajasringi | - <i>Odina pinnata</i> |
| 2. | Asoka | - <i>Saraca asoca</i> |
| 3. | Aswatha | - <i>Ficus religiosa</i> |
| 4. | Arka | - <i>Calotropis gigantea</i> |
| 5. | Kakadasingi | - <i>Gynandropsis pentaphylla</i> |
| 6. | Kuverakshi | - <i>Bignonia suaveolens</i> |
| 7. | Maharksha (Vijra) | - <i>Euphorbia tirucalli</i> |
| 8. | Neem | - <i>Azadirachta indica</i> |
| 9. | Nyagrotha | - <i>Ficus indica</i> |
| 10. | Palasa | - <i>Butea frondosa</i> |
| 11. | Stapuspa | - <i>Anethum sowa</i> |
| 12. | Sikhandi (Juha) | - <i>Jasminum auriculatum</i> |
| 13. | Vidanga | - <i>Embelia ribes</i> |

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indicum, coconut water, *Embelia ribes* and cow ghee, etc were in vogue.

Since then use of plant parts in various affairs of agriculture was on the increase and people domesticated varieties of plants around their habitation and agricultural fields. Instances of best known plants species used by man during Vedic and the periods thereafter are cited in Tables 2 and 3.

In the first century B.C. and sixth century A.D. Shih Shary-han brought out an encyclopaedia of agriculture in China listing a large number of practices for sustainable agriculture. Roychoudhary² enlisted numerous traditional agricultural practices found in Indian ancient texts on Vrikshayurveda (tree medicine), and Asura-Vaidyaka (treatments of horse and

Table 3 — Important traditional pest control plants

| Plants | Parts used | Major mode of action | Target pests |
|---|------------------------|--|-------------------------------------|
| <i>Acorus calamus</i> | Rhizome | Contact poison repellent | Ants |
| <i>Allium cepa</i> | Bulb, leaf | Repellent | All pests |
| <i>Allium sativum</i> | Bulb | Repellent | All pests |
| <i>Annona squamosa</i> | Leaf, seed | Contact poison | All pests |
| <i>Azadirachta indica</i> | Leaf, seed | Repellent, antifeedant, growth regulator | BPH, GLH Aphids, larvae |
| <i>Adhatoda vasica</i> | Leaf | Antifeedant, repellent | Stored pests, rice pests |
| <i>Acacia nilotica</i> | Flowers, stem wood ash | Contact poison, antifeedant | Termite, stored pests |
| <i>Agave americana</i> | Leaf | Contact and stomach poison | Rice leaf folder |
| <i>Calotropis gigantea</i> | Leaf | Stomach poison | Larvae |
| <i>Capsicum frutescens</i> | Fruit | Stomach poison | Larvae, sucking pests |
| <i>Chrysanthemum cinerariaefolium</i> | Flower | Contact and stomach poison | All pests |
| <i>Curcuma domestica</i> | Rhizome | Contact poison | Rice pests, stored pests |
| <i>Cycas revoluta</i> | Male cone | Repellent | Rice earhead bug |
| <i>Datura stramonium</i> | Leaf | Antifeedant | Larvae |
| <i>Ipomoea carnea</i> ssp. <i>fistulosa</i> | Leaf | Stomach poison | Larvae |
| <i>Melia azadirach</i> | Bark, leaf, seed | Attractant, repellent | |
| <i>Nicotiana tabacum</i> | Leaf | Repellent, stomach poison | Sucking pests, larvae |
| <i>Ocimum sanctum</i> | Leaf | Repellent, antifeedant | Rice pests, beetles, fruit flies |
| <i>Piper nigrum</i> | Seed | Stomach poison | Larvae, beetles |
| <i>Pongamia pinnata</i> | Oil cake | Antifeedant | Stored pests |
| <i>Tecoma indica</i> | Flower | Contact poison | Stored pests |
| <i>Vitex negundo</i> | Leaf | Contact poison, growth regulator | Stored pests, sucking pests, larvae |
| <i>Zingiber officinale</i> | Rhizome | Repellent | Stored pests |

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other animals). Indigenous botanical knowledge in agriculture with reference to seed treatment, pest control, seed storage, horticulture etc. was compiled by Mazumdar³. Chandrakanth and Basavaradhya⁴ and Vijayalakshmi and Shyamsundar⁵ traced records of ancient

texts of India viz., Varahamihira, Brihatsamhita (5 A.D.) Vrikshayurveda of Loko pakakra (5 A.D.) and Sarangadhara Samhita (13 A.D.) in respect of plant protection techniques.

In India during the early period, the knowledge of pest control in agriculture

was propagated through folk songs, folklores, proverbs, riddles, street dances, etc.⁶⁻⁸

It is also found that the world Tamil poet Thiruvalluvar in his classical masterpiece, 'Thirukkural', has made a mention of infestation of stem borer in rice and subsequent loss of the crop. Diseases in betelvine and coconut have also been indicated. In particular, the following 'kural' (couplet) illustrates growing of crops with proper manure care and protection against pests and diseases.

'Erinum nanral eruvidudal kattapin
Neerinum nandraam kappu'

(Couplet No. 1038)

References on traditional agriculture are also found in the ancient Sanskrit literature. The sages have said that preservation of the best kind of seeds from the attack of the pests would bring prosperity to the cultivators⁹. It is therefore clear that our traditional knowledge in agriculture dates back to prehistoric, historic, Vedic and medieval periods.

To promote the cause of traditional knowledge in human welfare and agriculture, first ever national gathering of scientists, peasants, artisans, extension workers etc. under a title, 'Indigenous technologies for sustainable agriculture' was organised at Indian Agricultural Research Institute, New Delhi in 1993. Following this, three Congresses on 'Traditional sciences and technologies of India' were held at Bombay (1993), Chennai (1995) and Varanasi (1998). These congregations have given an

excellent opportunity to the participants to exchange and disseminate details of various kinds of traditional knowledge in agriculture and other life activities.

Traditional pest control

Thus it is important that such traditional farm practices are promoted and encouraged among the farming communities as an effort not only to tap the local knowledge but also to make use of locally available resources in crop production. It is in this context, the author and his team of research scholars made a pioneering study to collate pest control techniques of yesteryears prevailing in remote villages and tribal pockets in Tamilnadu. This led us to introduce a new concept in pest control namely '**Traditional pest control**'. All the tradition-bound materials used in pest control are named as '**Traditional pesticides**'.

Baskaran and Narayanasamy¹⁰ documented and catalogued 1000 odd indigenous pest control techniques, of which 700 pertain to field and horticultural crops and the rest to grain storage. A set of 22 traditional practices was evaluated against pests of rice in laboratory and field conditions and another set numbering 21 against stored grain pests¹¹. Then Rethina Raja¹² tested mixtures of plant products in specific combinations against pests of brinjal, *bhendi* and tomato and came out with recommendations. In the light of these, detailed findings of our series of investigations made so far are discussed here.

Traditional practices against the pests of rice

Among the selected traditional pesticides tested, general leaf mixture + asafoetida extract followed by tobacco leaf waste extract, brick kiln ash and ash gave very good control of the brown planthopper (BPH). It is noted that monocrotophos did not fair well. Odour of Cycas male cone affected the landing of the BPH on the plant. Effectiveness of similar traditional materials has already been made known¹³⁻¹⁷. Neem products, *Jatropha* plant extract and green chilli were also equally effective against the hopper. Development of crude oil from *Jatropha* as a source of safe and effective pesticide is a breakthrough in the control of weevil of rice grains, cockroaches, rats, houseflies, etc.¹⁸ Pungency of chilly might be a possible reason for its effectiveness. Neem through its bitter principles called meliacins like azadirachtin, nimbin, salannin, meliantriol etc. has been reported to be antifeedant against several pests^{13,19}.

In a field trial, lowest population of the green leafhopper (GLH) was observed in plots treated with rice bran+kerosene mixture. However, brick kiln ash, saw dust+kerosene too checked the GLH incidence effectively. This finding confirms the earlier reports^{14,17}. Presence of silica in the rice bran, kiln ash and the saw dust might be the killing principle. Other traditional substances like tobacco waste extract, Cycas cone, and *mahuva* oil had shown moderate action on the population of the GLH and white backed planthopper throughout the crop period.

Lime + ash and green chilli extract were found effective against the leaf folder. The presence of silica in the ash and lime might have deterred the larvae from feeding.

Cow dung extract, Cycas cone and brick kiln ash were superior against the yellow rice borer. The strong odour of the Cycas flower emanating due to putrefaction of proteins and amino acids in the presence of moisture might have deterred the adult moth from laying eggs on the plant. The cow dung extract by its coat on the rice leaf would have deterred the moths from oviposition.

Treatments such as *Vitex negundo* leaf extract followed by neem oil, agave flesh extract and tobacco leaf waste extract effectively reduced the borer incidence. Effectiveness of neem oil as a pesticide has been abundantly quoted^{19,21}.

Among different concentrations of Cycas cone extract, 25% concentration repelled the earhead bug to the maximum followed by 20% extract. Most of the pre-starved bugs fed on the inflorescence of paddy treated with Cycas water extract; however, no mortality was encountered. Hence the farmers keep the Cycas cone pieces in the field bunds at the time of flowering stage of the rice plant to tackle the bug menace (Fig. 1). This is in vogue in the Puliyangudi taluk of Tirunelveli district in Tamil Nadu¹⁶.

Pests of stored paddy

In trials conducted at the godowns of Central Warehousing Corporation and the Food Corporation of India, *V. negundo* leaf dust followed by neem seed kernel powder were effective against

Rhizopertha dominica. The efficacy of the neem seed kernel may be due to its rich content of meliacins and 0.2-0.3% azadiractin and 30% oil though neem leaves, seed coat and bark also contain these but in small quantities²². In both the experiments *Eucalyptus* and *Cinnamomum* tree bark mixture 4% was totally ineffective against the pest as inferred by Ebsan.²³ It was observed that efficiency of the treatments was steadily good up to 75 days but thereafter the activity decreased and hence a second treatment of the seed is required to be given to keep the pest population under check¹¹. In the subsequent study, treatments such as *Adhatoda* leaf dust 10%, ash 5%, *Cycas* cone powder 10%, neem leaf powder 10%, neem seed kernel powder 5%, *V. negundo* leaf powder 10% and tobacco leaf dust 5% were given. Of these, neem seed kernel powder 5% gave superior check of *R. dominica* followed by tobacco leaf dust 5%. Repellency of neem seed kernel against the beetle was uniform up to 120 days.

In a laboratory study, neem and *datura* leaf mixture had caused highest mortality of the pest followed by *V. negundo* leaf dust. Maximum mortality of *Tribolium castaneum* was recorded with the neem seed kernel powder 2% followed by *Ipomoea* 4%. In fact the mortality of the pest was witnessed from third day onward confirming the earlier findings²⁴⁻²⁶.

Regarding *Corcyra cephalonica* maximum mortality was caused by *V. negundo* leaf powder followed by neem leaf powder, *Adhatoda* leaf powder. Pupation of *C. cephalonica* larvae was

inhibited by *V. negundo* leaf powder and tobacco leaf waste. Common ash disrupted the adult emergence to the maximum. Presence of silica in the ash might be the principle responsible for the mortality of the test insect; aberration of the body tissues was its common feature.

Traditional practices against pests of vegetables

Brinjal

In a field trial, damage by fruit borer (*Leucinodes orbonalis*) was kept low due to a mixture of extract of garlic, kerosene and green chilli and another mixture having garlic, onion and chilli powder. The insecticidal property may be due to pungency of garlic, onion and chilli. However, another extract containing agave, nux-vomica and neem leaves, *Pongamia* cake and cow urine too controlled the fruit borer and leaf beetle (*Epilachna vigintioctopunctata*) incidence. These findings concur with the earlier reports²⁷⁻²⁹. Repelling nature of cow urine, bitterness of *Pongamia* cake and poisonous nature of nux-vomica accounted for the insecticidal property. These treatments were detrimental to survival of larval population, fecundity, egg hatchability, adult longevity and adult emergence in *Epilachna* beetle (*E. vigintioctopunctata*).

Bhendi

In field, mixture of garlic, kerosene and green chilli brought down incidence of fruit borer (*Earias vittella*) and leafhopper (*Amrasca devastans*) infesting bhendi seedlings.]



Fig. 1—Male cone of Cycas

Tomato

The fruit borer (*Helicoverpa armigera*) and leaf caterpillar (*Spodoptera litura*) were controlled effectively by the treatment comprising garlic, kerosene and green chilli. These treatments also hindered adult emergence in *H. armigera* and *S. litura* besides inducing adult malformation to certain extent.

A wild chilli (*Capsicum frutescens* Linn.) (Tamil: *Kaandhari chilli*) grows commonly in the hilly tracts around Tirunelveli district in Tamil Nadu. The unripe fruits are very small (Fig. 2) having high level of pungency. The farmers of the tract use the chilli fruit as a spray against pests of rice and other crops¹². Rethina Raja and Narayanasamy³⁰ recorded pupal mortality and inhibited adult emergence in *S. litura* and *H. armigera* due to green chilli paste treatment.

Economics of traditional pesticides

Regarding economics of plant protection with traditional pesticides, it is observed that the inert dust materials like ash and brick kiln ash are cheap and available in abundance. But neem oil, garlic and mahuva oil cost about Rs. 60 a litre. The cost of crop protection for an hectare could be within Rs. 290/-.

As the plants of *Agave*, milk weed and *Ipomoea* are abundantly seen in and around the agricultural fields, waste lands and along the road sides, they may be used profitably besides managing them. Cycas flower if processed as powder or as an extract and preserved will be useful against the pests of rice and other crops.

So far as the pest control in the storage grains is concerned, most of the plant products are available commonly. If tobacco leaf waste could be collected from the field, there will be no cost. Thus the traditional pesticides are cheaper.

In the light of the above, the following packages of "**Traditional pest management**", separate for rice and certain vegetables, are suggested for



Fig. 2—*Capsicum frutescens* — plant

sustainable agriculture^{11,12,31,32}, which would encourage the farmers to go in for pesticide-free crop protection to a certain extent.

1. Traditional pest management in rice

| | Dosages | Pests |
|---|----------|-----------------------------------|
| • Leaf mixture extract + asafoetida mixture | 1% spray | BPH, GLH, leaf folder, stem borer |
| • Tobacco leaf waste extract | 5% spray | |
| • Rice bran+kerosene | 37kg/ha | |
| • <i>Vitex negundo</i> leaf extract | 5% spray | |

| | Dosages | Pests |
|-------------------------------|----------|---|
| • Lime ash mixture | 37kg/ha | Earhead bug, BPH, leaf folder, stem borer, caterpillars and other chewers |
| • <i>Cycas</i> cone pieces | 370g/ha | |
| • Cow dung extract | 2% spray | |
| • Brick kiln ash | 37kg/ha | |
| • <i>Ipomoea</i> leaf extract | 2% spray | |

2. Traditional pest management in brinjal

- Spray extract of leaves of *Agave* + *Nux vomica*+cow urine+*Pongamia* seed cake.
- Spray extract of leaves of *Adhatoda vasica* + *Aegle marmelos* + *Vitex*

negundo + Neem seed kernel +
Asafoetida + Cow urine.

3. Traditional pest management in *bhendi* and tomato

- Spray extract of garlic + kerosene + green chilli.
- Spray leaf extract of *Agave americana*.
- Spray extract of garlic + onion + chilli powder.

The final extract shall be diluted in the water at 1:8 ratio. The treatments shall be delivered alternatively at 30, 45, 60, 75 days after planting in the respective crop.

4. Traditional pest management in stored paddy seeds in godown

- *Vitex negundo* leaf powder ... 4 kg/100kg seeds
- Neem seed kernel powder ... 2 kg/100kg seeds
- Tobacco leaf waste powder ... 2 kg/100kg seeds
- Neem leaf powder ... 4 kg/100kg seeds
- Common ash ... 2 kg/100kg seeds

Conclusion and future recommendations

We have a vast wealth of plants, which are rich sources of bio-active compounds. Several more might still be lying unexplored. More concerted efforts are needed to make the available compounds more potent against pests and safer to the environment by way of improved formulations.

The farmers still have inhibition in using botanicals because they are under the impression that they are inferior to the modern pesticides as the former do not cause quick knock down effect. Hence, an awareness among the farmers needs to be created in this regard.

The traditional substances, which are less frequently used in India at present, may provide a suitable alternative to the chemical pesticides. If the practice of involving traditional substances along with other biological products is followed for the pest problems, it is certain that the agriculture will be really green and the human kind will live in a very safe and healthy environment.

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