Traditional knowledge of tribals in crop protection

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The paper reviews the scenario of pest control activities adopted by the tribals envisioned towards pursuing organic agriculture in the light of the hazards of chemical pesticides posing serious threat to human, animal and environmental life. Pioneering investigations were undertaken at Annamalai University to cover major tribal groups of Tamil Nadu like Malayali Gounder, Irulas, etc. living in hills, namely Kalrayan, Kolli, Nilgris, Pachamalai, Javvadu, Elagiri, Yercaud and Varusanadu brought in to focus plethora of pest control techniques and innovative pest control devices adopted by them. Certain potential practices were tested and potentiated by suitable amendments in the dosages and timings of application for attaining best plant protection. This culminated in evolution of packages of practices known as Tribal Pest Management Systems for important pests in rice and vegetables.

Keywords: Tribal pesticides, Tribal rat trap, Atti, Ethnesticides, Crop protection, Traditional Knowledge, Tribal Pest Management, Traditional Pest Management

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Among the tribal communities, adivasis or the so-called aboriginal population in our country is considered the early settlers. They live in most unhealthy jungles covered regions, mostly inaccessible to other people. The tribal folks have been utilizing varieties of plant based products, crop residues like ash, husk, etc. animal products like cow dung, red earth, etc. for protecting their crop plants in field and in storage of food grains listed below.

Eco-based tribal pesticidal substances

<table>
<thead>
<tr>
<th>Kitchen Ash</th>
<th>Wood ash</th>
<th>Lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>Red earth</td>
<td>Cow dung</td>
</tr>
<tr>
<td>Cow dung ash</td>
<td>Table salt</td>
<td>Ragi husk</td>
</tr>
<tr>
<td>Laterite soil</td>
<td>Fish</td>
<td>Goat dung</td>
</tr>
<tr>
<td>Goat urine</td>
<td>Farmyard manure</td>
<td></td>
</tr>
</tbody>
</table>

Most of these substances are safe, biodegradable, less persistent, non-toxic and easily available in and around their house tenements and land. The tribals subsist on foods, tubers, fruits and nuts available in the forests of their habitation besides growing certain crops. This, over years has led to creation and adoption of crop production techniques of their choice and ability thus producing crops at specific season required for their livelihood.

Tribal agriculture

Agriculture is the main occupation of the tribals in Tamil Nadu. Due to varying agroclimatic conditions, technological backwardness of tribal farming system, lack of education, etc. The tribal agriculture remained as subsistence sector. High labour, dry farming and static cropping pattern are the key features of the tribal agriculture in India.

The tribal communities in Tamil Nadu grow an array of crops. Tribes such as Kurumbas, Irulas, Todas, Kotas, Mullakurumbas and Panias perform intensified farming. Seed selection, storage and protection of food grains, tubers, etc. against the pest attack are the major activities done by the tribal women folks.

Especially Malayali tribal women have developed simple and useful indigenous methods of selecting the seeds and protecting them from the pests and the diseases. In all the Malayali tribe houses, atti is a common structure where seeds are preserved.

Cultivation of all the crop varieties starts after the southwest monsoon rains. According to the tribals, the success of cultivation depends on the time and amount of rainfall during June to August. Traditionally, most of the tribals adopt mixed cropping pattern. Following are some crops, which aims at managing the invading pests.

Mixed cropping by Irulas

- Peria ragi → Senthinai → Edusamai → Amaranthus → Vigna
- Sorghum → Senduragi → Amaranthus → Vigna → Vigna → Castor
Mixed cropping by Malayali tribe

- Panivaragu → Karunsamai → Fieldbean → Red gram → Mustard
- Foxtail millet → Karunsamai → Vigna → Red gram
- Ragi → Karunsamai → Vigna → Red gram → Mustard → Castor
- Ragi → Amaranthus → Mustard → Castor
- Greens → Karunsamai
- Pearl millet → Vigna → Red gram

The tribals aim to produce crops in different periods of one year to meet the food requirements and economic needs through mixed cropping. The available land, water and soil nutrients are efficiently utilized to produce crops necessary for their livelihood. Tribals depend upon the organic manures like cattle refuse, green manure and domestic wastes and also the cattle are gathered in a land for certain period so as to enrich the soil with nutrients. Leaves of neem, pungam, Calotropis gigantea R. Br. and Cassia javanica Linn. are regularly used as green manure.

Tribal pest control knowledge

In the light of the various farm practices adopted by the tribes, it is of interest to focus on various crop protection techniques, which are synthesized and perpetuated by them traditionally. It is observed that they are interested in preserving seeds and tubers free off the pests infestation in storage. In the field too, the tribals practice indigenously inherited pest control techniques to produce pest-free crops. In all the measures of pest control varieties of pesticidal plant species including Neem, Vitex negundo Linn., Adhatoda vasica Nees and Calotropis gigantea R. Br. are used (Table 1) (Figs. 1, 2, 3).

No concerted effort was undertaken to document and upkeep the tribal practices used in the pest control, however, some reports of tribal based pest control knowledge from various hills in Tamil Nadu are available\textsuperscript{1-4}. Indigenous folk practices among Nilgriris Irulas, certain agricultural practices adopted by Malayali Gounder and Irula tribals in Palani hills in Tamil Nadu, the tribes of Kalrayan and Kolli hills in Tamil Nadu\textsuperscript{5, 6} and six primitive tribal groups inhabiting in the Nilgiris District in Tamil Nadu for various crop production techniques are reported\textsuperscript{7}. Good number of pest control practices adopted by the tribes of Pachamalai in Tamil Nadu agricultural practices followed by Malayali tribals is also reported\textsuperscript{8, 9}.

<table>
<thead>
<tr>
<th>S No</th>
<th>Common name</th>
<th>Botanical name</th>
<th>Pest (s) controlled</th>
<th>Parts used</th>
<th>Mechanisms of action on insects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chilli</td>
<td>Capsicum annuum L.</td>
<td>Pulse beetle</td>
<td>Fruit powder</td>
<td>Insecticide</td>
</tr>
<tr>
<td>2</td>
<td>Neem</td>
<td>Azadirachta indica (Juss)</td>
<td>Store grain pests</td>
<td>Leaf, twig, bark &amp; seeds</td>
<td>Contact, stomach poison &amp; repellant</td>
</tr>
<tr>
<td>3</td>
<td>Indian privet</td>
<td>Vitex negundo L.</td>
<td>Store grain pests</td>
<td>Leaf &amp; twigs</td>
<td>Contact poison &amp; growth inhibitor</td>
</tr>
<tr>
<td>4</td>
<td>Smooth volkamera</td>
<td>Clerodendron philomoides L.</td>
<td>Store grain pests</td>
<td>Leaf</td>
<td>Anti feedent &amp; repellant</td>
</tr>
<tr>
<td>5</td>
<td>Acorus</td>
<td>Acorus calamus L.</td>
<td>Store grain pests</td>
<td>Rhizome</td>
<td>Anti feedent &amp; repellant</td>
</tr>
<tr>
<td>6</td>
<td>Tobacco</td>
<td>Nicotiana tabacum L.</td>
<td>Earhead bug &amp; leaf feeders</td>
<td>Leaf &amp; stem</td>
<td>Stomach poison &amp; repellant</td>
</tr>
<tr>
<td>7</td>
<td>Fox toil palm</td>
<td>Coryta urens</td>
<td>Leaf folder &amp; caseworm</td>
<td>Leaf</td>
<td>Anti feedent &amp; repellant</td>
</tr>
<tr>
<td>8</td>
<td>Kerala Plant</td>
<td>Sterculia urens Roxb.</td>
<td>Leaf folder &amp; case worm</td>
<td>Leaf</td>
<td>Antifeedant &amp; repellant</td>
</tr>
<tr>
<td>9</td>
<td>Panivaragu/Kodomillet</td>
<td>Paspalum scrobiculatum</td>
<td>Leaf hoppers in rice</td>
<td>Crushed powder from leaves, seeds &amp; bark</td>
<td>Deterrent</td>
</tr>
<tr>
<td>10</td>
<td>Babool</td>
<td>Acacia nilotica L.</td>
<td>Stem borer &amp; leaf feeders</td>
<td>Plant</td>
<td>Anti feedent</td>
</tr>
<tr>
<td>11</td>
<td>Cleistanthus</td>
<td>Cleistanthus collinus (Roxb.)</td>
<td>Beetle pests of rice</td>
<td>Leaf &amp; bark</td>
<td>Anti feedent</td>
</tr>
<tr>
<td>12</td>
<td>Pongam</td>
<td>Pongamia pinnata L.</td>
<td>Leaf &amp; sap feeders</td>
<td>Leaf</td>
<td>Antifeedant &amp; repellant</td>
</tr>
<tr>
<td>13</td>
<td>Castor</td>
<td>Ricinus communis L.</td>
<td>Rhinoceros beetle</td>
<td>Seeds &amp; cake</td>
<td>Attractant</td>
</tr>
<tr>
<td>14</td>
<td>Calotropis</td>
<td>Calotropis gigantea (L.) R.Br.</td>
<td>Pests of cucurbits</td>
<td>Leaf &amp; twig</td>
<td>Stomach poison &amp; growth inhibitor</td>
</tr>
<tr>
<td>15</td>
<td>Cycas</td>
<td>Cynca circinalis</td>
<td>Ear head bug of rice</td>
<td>Flowers</td>
<td>Repellent &amp; antifeedant</td>
</tr>
<tr>
<td>16</td>
<td>-</td>
<td>Holarrhena antidysenterica</td>
<td>Stem borer in paddy</td>
<td>Leaf &amp; twigs</td>
<td>Repellent &amp; antifeedant</td>
</tr>
</tbody>
</table>
Existence of nearly 40 forms of pest control practices adopted by the Malayali Gounder tribes living in Kalrayan hills in Tamil Nadu has been reported. A 2-year study to document and catalogue tribal knowledge based pest control practices in Tamil Nadu hills like Kolli, Kalrayan and Nilgiris was initiated. This resulted in compilation of a number of indigenous pest control practices followed by the tribal groups. Certain potential practices were further subjected to studies for enhancing their pesticidal activities for pests of rice and vegetables and store grains.

Recently, prevalence of more than 300 pest control techniques adopted by tribal groups, Irulas, Malayali Gounder and Todas enliving in hills like Kalrayan, Kolli, Javvadu, Yelgiri, Yercaud, Pachamalai, and Varusanadu have been reported. From the documentation of tribal knowledge, there was large share to do away store pests, followed by all pests and non-insect pests with 30, 27 and 20 per cent adoption (Table 2). Based on the performance, certain tribal practices were selected and subjected to detailed studies for more pest control in the field. Besides evaluating these practices against various kinds of pests.

**Bio-efficacy of tribal practices against pests of crops**

**Rice**

Among the tribal pesticides applied as foliar spray and dust over the plants, fuel wood ash and fish + neem leaf extract checked key pests like brown planthopper and green leafhopper. Leaf folder, another major pest of rice was also controlled with sprays of table salt solution and fish + neem leaf extract. Dusting Acacia timber saw dusts and fuel wood ash was found effective against the stem borer larvae. Potential nature of the Vitex negundo Linn. leaves extract + butter milk spray and Adathoda vasica Nees. leaves extract + cow dung slurry spray in rice have also been reported.

**Vegetables**

- A tribal treatment consisting of Calotropis leaf + garlic + onion + Chillipowder was found very effective against brinjal Epilachna beetle, pumpkin caterpillar and tomato fruitborer infestations.
- Jatropha leaf extract and Calotropis leaf extract showed promise to control fruit borer and whitefly in brinjal respectively.
- Vitex leaf extract was found superior against bhendi whitefly.
- Sweet flag leaf and rhizome extract was found good against pulses grasshopper.
- Mixture of fenugreek + betel vine + onion + buttermilk + castor oil showed its efficiency against the larvae of Spodoptera litura, a polyphagous pests of vegetables, millets, pulses and oilseeds.
- Vitex leaf extract gave excellent control of groundnut leaf miner and thrips.
- Calotropis leaf extract excelled all other treatments in curbing the tapioca whitefly infestation. Field efficacy of certain tribal pesticides for pests of rice, vegetables, groundnut and pulses has been reported (Tables 3, 4, 5, 6).

<table>
<thead>
<tr>
<th>S No</th>
<th>Treatments</th>
<th>Leaf folder (%)</th>
<th>Stem borer (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Vitex</em> leaves extract + butter milk extract</td>
<td>7.1a</td>
<td>6.1a</td>
</tr>
<tr>
<td>2</td>
<td><em>Lantana camera</em> leaves + <em>Ocimum</em> leaf extract</td>
<td>27.10e</td>
<td>29.80e</td>
</tr>
<tr>
<td>3</td>
<td><em>Nerium</em> + <em>Ipomoea</em> leaf extract</td>
<td>19.2d</td>
<td>20.04d</td>
</tr>
<tr>
<td>4</td>
<td><em>Agave</em> leaf extract + kerosene</td>
<td>14.70e</td>
<td>12.6e</td>
</tr>
<tr>
<td>5</td>
<td><em>Jatropha</em> leaves extract + cow urine</td>
<td>10.4b</td>
<td>10.20b</td>
</tr>
<tr>
<td>6</td>
<td><em>Adhathoda</em> leaves + cow dung slurry</td>
<td>6.6a</td>
<td>6.4a</td>
</tr>
<tr>
<td>7</td>
<td>Rice bran + kerosene</td>
<td>19.80d</td>
<td>20.50d</td>
</tr>
<tr>
<td>8</td>
<td><em>Venguruchan</em> stone + ash</td>
<td>10.00b</td>
<td>9.9b</td>
</tr>
<tr>
<td>9</td>
<td>Untreated check</td>
<td>36.11</td>
<td>33.31</td>
</tr>
<tr>
<td></td>
<td>CD (P = 0.05)</td>
<td>2.21</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Each value is a mean of 3 replications

Mean values with similar alphabets do not vary between each other
Store grain pests

Major store grain pests like rice moth, red flour beetle, pulse beetle and rice weevil could be tackled effectively with certain tribal pesticides. The effective treatments included dusting of salt powder, kitchen ash, Vitex leaves, Spray of Vitex leaves, cow dung ash, dusting of turmeric powder and mixture of neem leaves + Vitex leaves + turmeric powder.

Application of kitchen ash, mixture of chilli powder + lime + ash and Clerodendron leaf extract showed their utility in godown condition.

Detection of tribal pest trapping/repelling devices

A bird scarer for ragi and a tribal rattrap have been described earlier. Granite rocks exposed in the land are painted with lime solution only to ward off pig menace during night in tapioca fields. Wood ash or kitchen ash is mixed with water to get a paste or gel. The mixture is smeared over the body of men and women to deter mosquitoes and other biting flies. A mosquito repeller made of an iron container with series of round holes at the top and bottom provision to accommodate mixture of leaves of neem, Leucas, Anna (a weed) and Chrysanthemum flowers was identified in various pockets of tribal regions in Tamil Nadu. Tribal rattrap used by the Malayali gounder tribe in Pachamalai, Kolli and Kalrayan hills has also been reported. The tribal trap is made up of a flat granite...
stone and three short pieces of long sticks measuring 10cm each (Fig. 7). The trap is set up in such a way that the rats will get trapped under the stone when the sticks are dislodged, while the animal attempts to take away the food. As the sticks are prone to damage easily, frequent replacement of them is warranted. The trap therefore, needs modification for better and sustainable use of the different parts and hence, a remodelled tribal ratttrap was prepared and its efficacy was tested in the rice field bunds \(^\text{12}\).

The modified rat trap consists of a flat concrete block of 30 X 25 X 5cm size, a Y- like wooden stick made of neem wood with arms having 7.5cm long each and a central arm 16cm length (Fig. 8). The trap was evaluated for its performance against the rat in rice field during samba season (October December 2000) in comparison with a conventional trap called ‘Thanjavur bow trap’ used commonly in Tamil Nadu (Fig. 9). Thirty numbers of each such trap were installed in an acre of rice and studied for 35 days. Based on the number of rats trapped, remodelled ratttrap excelled the other trap in getting the rats killed by the concrete throughout the period of study. Low cost ratttrap shows promise to kill the rats for longer period.

**Economics of tribal pesticides**

In general, most of the tribal pesticidal materials are very cheap as they are available locally. The material used in the study is non-toxic, ecofriendly and biodegradable. Plants like Neem, Adhatoda, Vitex, Calotropis, etc. can be procured from the natural habitats without any expenditure. Ashes of kitchen waste, cow dung, Acacia twigs, etc. can also be obtained with ease and used in the field freely.

Based on the findings obtained, packages of tribal pesticides have been developed for various crops.

**Tribal pesticides for rice**

**All pests**
- Fish (3kg) + Neem leaf (5kg) extract
- Table salt solution spray 4%
- Goat dung extract 7%
- Fuel wood ash dusting @ 16kg/ac
- *Acacia* timber sawdust @ 16kg/ac

**Leaf folder**
- *Vitex* leaf extract + Buttermilk spray
- *Adhatoda* leaf extract + cow dung spray

**Tribal pesticides for vegetables**

**Brinjal Leaf beetle**
- *Calotropis* leaves + Garlic + onion + chilli powder spray
- *Vitex* leaf extract spray

**Tomato fruitborer**
- *Calotropis* leaf + garlic + onion + chilli powder spray
- *Vitex* leaves extract spray

**Bhendi fruitborer**
- *Vitex* leaves extract spray
- *Jatropha* leaf extract spray

**Groundnut cutworm**
- *Vitex* leaves extract spray
- *Calotropis* + Garlic + Onion + Chilli powder spray

**Storage pests**

**Rice weevil**
- *Vitex* leaf extract spray
- *Vitex* leaves + neem leaf extract spray

**Pulse beetle**
- Dusting turmeric powder
- Dusting powdered *Vitex* leaves

**Conclusion**

There is abundance knowledge and practice of the tribals in crop protection, which need to be tapped for the present and future agriculture. The tribal pesticides are excellent alternatives to the chemical pesticides in conjunction with other organic based pest management components like biopesticides, resistant crop varieties, sex lures, light traps, etc. The tribal folks need awareness campaign and education on improved non-chemical plant protection techniques. There is a need to organize tribal farmers contact programme. Substances of plants and animal origin need to be concentrated for effective pest control.

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