Use of Botanicals by Farmers for Integrated Pest Management of Crops in Karnataka

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Abstract

Agriculture has been facing the destructive activities of numerous pests like fungi, weeds, and insects from time immemorial, leading to radical decrease in yields. Insect pests are the big enemies of farmers as they destroy crops, stored grains; act as a vector of diseases of livestock etc. Chemical pesticides are used to control these pests, but their indiscriminate use has resulted in development of insecticide resistance in pests, and higher levels of residual toxicity resulting in conversion of fertile lands into infertile and toxic. In addition it also contributes to environmental pollution by contaminating air, soil and water which results in health hazards to human and wild life. Growing public awareness and concern about the adverse effects of pesticides have necessitated the need to look for eco–friendly, safer and effective organic methods of pest control. The best solution for this is to follow indigenous traditional ways of pest control followed by farmers by using plants which were once prevalent all over the world, but with the advent and use of modern synthetic pesticide these have almost vanished from the developed countries and are mow confined to some regions of developing countries. More than 2500 plant species belonging to 235 families have been found to possess the characteristic properties required for an ideal botanical insecticide. Hence an attempt was made during Rural Agricultural Work Experience program (RAWE) to acquire information on the indigenous botanical sprays used by the farmers in Segalapalli, Kamtampalli, and Tadigol Villages of Srinivaspura Taluk, Kolar District of Karnataka.

Insect pests are the big enemies of farmers as they destroy crops, stored–grains; act as a vector of diseases of livestock etc. Indiscriminate use and overdependence on chemical pesticides in pest control also resulted in insecticide resistance in pests, pest resurgence which results in minor pests attaining major status, elimination of natural enemies, higher levels of residual toxicity in soil, environmental pollution by contaminating air, soil, and water which have harmful effect upon human and wild life. Therefore, it has now become necessary to search for the alternative means of pest control, which can minimize the use of synthetic pesticides.

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(natural enemies) which offers a good alternative to manage the insect, pests, and diseases in an eco–friendly way. Botanicals are extracted from various plant parts (leaves, stems, seeds, roots, bulbs, rhizomes, unripe fruits, and flower heads etc.) of different plant species. Plant extracts are also called as Green Pesticides, Botanical Pesticides, Plant Pesticides, Botanicals, Ecological pesticides and the method which utilizes botanicals in insect pest management is called as Indigenous Integrated Pest Management or Ethno–Botanical Crop Protection. Botanical pesticides possess an array of properties including toxicity to the pest, repellent, anti–feedant, insect growth regulatory activities against pests of agricultural importance. These have broad spectrum activity, are less expensive and easily available because of their natural occurrence, have high specificity to target pests, and no or little adverse effect on beneficial insects, resistance development to them is slow or less common, poses least or no health hazards and environmental pollution, have less residual activity and are effective against insecticide resistance species of insects, and have no adverse effect on plant growth parameters. More than 2500 plant species belonging to 235 families have been found to possess the characteristics required for an ideal botanical insecticide. About 350 insecticidal compounds, more than 800 insect feeding deterrents, and a good number of insect growth inhibitors and growth regulators have been isolated from various plant species.

Methodology

The present study was conducted in Segalapalli, Kamtampalli and Tadigol Villages of Srinivaspura Taluk, Kolar District of Karnataka state. Authors had stayed in the village during Rural Agricultural Work Experience program for a period of one month to gather information on indigenous botanical sprays used by the farmers for insect pest management and information was obtained from local farmers through personal contact. Frequent field visits were organized for data collection, confirmation and finalization by repeated visits to the same localities.

Results and discussion

All the available efficient indigenous botanical sprays commonly used by the farmers are presented in table1. Overall study indicated that farmers used locally available natural resources for the management of insect pests. There were 14 types of indigenous botanical sprays used by the farmers in different crops against

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different insect pests like *Helicoverpa armigera* (fruit borer), *Spodoptera litura* (Leaf eating caterpillar), *Leucinodes orbonalis* (Brinjal fruit and shoot borer), Amsacta *albistriga* (Red headed hairy caterpillar), pod borers of pulses, tobacco caterpillar, Tea mosquito bug, Thrips, Jassids, Aphids, Termites, Spider mites, Beetles, leaf miners, defoliators, whiteflies, scales etc. All these sprays have been used since ancestral period. The information on methods of preparation of these botanical sprays was also collected from the farmers.

Table 1. Indigenous botanical sprays used by the farmers to control insect pests in crops.

Botanical	Target pests
Neem leaf extract	Defoliators and Sucking pests
Garlic extract	*Spodoptera litura* (leaf eating caterpillar), *Helicoverpa armigera* (fruit borer), and other lepidopteran pests
Garlic-Chilli-extract	*Helicoverpa armigera* (fruit borer), *Spodoptera litura* (leaf eating caterpillar), *Leucinodes arbonalis* (Brinjal fruit & shoot borer), *Amsacta albistriga* (red headed hairy caterpillar)
Fermented botanical spray	*Leucinodes orbonalis* (Brinjal fruit and shoot borer), Pod borers of pulses, Tobacco caterpillar (*Spodoptera litura*)
Adathoda vesica leaf extract	Defoliators and Sucking pests
Datura plant extract	Tea mosquito bug, Thrips, Jassids, Aphids
Ekka leaf extract	Termites
Lantana leaf powder	Aphids
Lantana leaf extract	Beetles, Leaf miners, Defoliators
Mixed leaves extract	Defoliators like Spodoptera litura, semi loopers
Panchapatre	Defoliators, Fruit borers, Sucking pests like Aphids and Whiteflies
Nilgiri leaf extract	Jassids, Aphids, Scales
Chilli – Neem– Garlic exract	Lepidopteran pests in Pigeon pea
Multiple plants leaf extract	Major pests and diseases

Methods of preparation of different indigenous botanicals by farmers

Neem (*Azadirachta indica*) leaf extract

Materials required: Neem leaves (80kg/ha).

The fresh neem leaves were collected and soaked overnight in water. Next day, soaked leaves were taken out and ground and the extract obtained was filtered. The filtered extract was diluted @ 2.5–3 L in 50 L water and sprayed.

Garlic (*Allium sativum*) extract

Materials required: Garlic bulbs (30gm).

30g of garlic bulbs were ground thoroughly in grinder with 50ml water. Ground mixture was soaked in little quantity of water over night and squeezed through muslin cloth and the volume was made up to 1L by adding water and sprayed.

Garlic–Chilli (*Capsicum annum*) extract

Materials required: Green Chilli 30g, and Garlic 30g.

Garlic bulbs and green chilli (30g each) were ground separately in a grinder with little water. Grinded material was soaked in water overnight separately and the extract was squeezed using muslin cloth, both were mixed and the volume was made up to 1 L to obtain 3 per cent concentration.

Fermented botanical spray

Materials required: cow dung (6kg), cow urine (6L), Calotropis (*Calotropis gigantea*) leaves (5kg), Vitex (*Vitex negundo*) leaves (5kg), Neem leaves (5kg), Adhatoda (*Adathoda vasica*) leaves (5kg), and Pongamia (*Pongamia pinnata*) leaves (5kg).

A plastic barrel of 200L capacities was taken and above mentioned materials + small quantity of soil below the tree was added. The whole mixture was stirred daily for four weeks. The mixture was filtered through a double–layered muslin cloth. The filtered extract was diluted and sprayed. This preparation is a variant of *kunapajala* described by Surapala in his Vrikshayurveda

Adhatoda (*Adhatoda vesica*) leaf extract

Materials required: Adhatoda leaves (1kg).

Leaves (1kg) of Adhatoda were ground and mixed with 10L water and kept undisturbed for 24h and then filtered through a muslin cloth and sprayed.

Datura (*Datura stramonium*) plant extract

Materials required: Datura leaves (1kg), and Datura pods (1kg).

Leaves and pods of Datura were dried and powdered by pounding. This powder was soaked in 40L water and kept for 24h and then filtered through a muslin cloth and sprayed.

Ekka [Calotropis (*Calotropis gigantea*)] leaf extract

Materials required: *Ekka* leaves (5kg).

Ekka leaves were sun dried and powdered by pounding and the powder obtained was soaked in 50L water and kept for 24h then filtered through a muslin cloth and sprayed.

Lantana (*Lantana camera*) plant powder

Materials required: Lantana branches with leaves and immature fruits (5kg).

Lantana branches with leaves and immature fruits were chopped and dried. The dried material was grinded to prepare powder and the powder was mixed with 100L water and sprayed.

Lantana (*L. camera*) leaf extract

Materials required: Lantana leaves (1kg). Lantana leaves (1kg) were chopped and ground with little water and filtered. This filtrate was diluted in 30L of water and sprayed.

Mixed Leaves Extract

Materials required: cow urine (10L), Custard apple (*Annona squamosa*) leaves (2kg) Papaya leaves (2kg), Pomegranate leaves (2kg), Guava leaves (2kg), Neem leaves (2kg), Pongamia leaves (2kg), and a Copper container of 20 L capacity.

All the leaves were crushed and 10L of cow urine was added. The above mixture was boiled till the mixture became half of the initial. The boiled leaves were kept for 24h without disturbing. The leaves were then squeezed and the extract was collected separately and filtered. The extract was diluted @ 2–2.5L in 50L water and sprayed.

Panchapatre

Materials required: Calotropis (*Calotropis gigantea*) (1kg), Neem (1kg), Adhatoda (1kg), Vitex (1kg).

The above mentioned plant leaves were ground and transferred to a plastic drum in 15L water, 1L cow urine, and 50gm asafetida was added. The mouth of the plastic drum was tightly tied with a cloth. This mixture should be mixed well daily and used after a week after filtration.

Nigeria (*Eucalyptus globules*) leaf extract

Materials required: Eucalyptus leaves.

Boil tender leaves of eucalyptus (1kg in 2L water) for one hour in low flame. Filter it next day and dilute with 20L water and spray.

Chilli–Neem–Garlic extract

Materials required: Chilli, Neem leaves, and Garlic.

Chilli, Neem leaves and fresh Garlic paste was taken in 1:4:1 proportion and boiled with 15 times water for 45 minutes to one hour in low flame and filtered the solution and mix it with 50L of water and sprayed.

Multiple plant extract

Materials required: Cow dung (15kg), Cow urine (5L), Calotropis (3kg), Parthenium (3kg), Lantana (3kg), Datura (3kg), Pongamia oil cake (2kg), Neem seed kernel extract (1L), Jaggery (1kg), Ash

(1kg), and Plastic barrel of 200L capacities.

All the plant materials were chopped and filled in plastic drum with 200 L water. All ingredients were stirred well and the drum mouth was closed with a lid and allowed it to ferment for one week. After a week the whole mixture was filtered. The filtered liquid was used through irrigation water @ 200 L/ha.

Scientific rationale of using botanicals as pesticides

Neem (*A. indica*). Azadiractin, Melantriol, Nimbinin, Nimbidin, Salanin, Nimbin, Nimbolin A, and Nimbolin B are the active principles present in neem leaf extract. These compounds show anti–feedant, repellent, oviposition deterrent and insect growth regulator activity against insect pests (Vijayalakshmi *et al.*, 1995, 1996; Kwasi Opoku Boadu *et al*., 2011, Subbalakshmi *et al.*, 2012; Misra, 2014).

Garlic (*A. sativum*). Allicin and Diallyl sulfide are the active principles present in garlic extract, which have insecticidal activity (Prowse *et al.*, 2006).

Chilli (*C. annum*). Chilli extract contains Capsacin as the active principles, which has repellent and deterrent activity against insect pests (Madhumathy *et al*., 2007).

Vitex (*V. negundo*). Vitexin and negundoside are the active principles present in the V. negundo, which show repellent activity against insect pests (Prasad, 2011).

Calotropis (*C. gigantea*). Calatropin and Calotoxin are the active principles present in calotropis, which show anti–feedant, repellent, oviposition deterrent and insect growth regulator activity against insect pests (Rohit Sharma *et al*., 2012; Baby Josephet al., 2013; Suresh Kumar *et al*., 2013).

Adhatoda (*A. vasica*). Vasicine, Vasicinone and Adhatodin are the active principles present in the Adhatoda, which show repellent and insecticidal activity against insect pests (Emimal Victoria, 2010; Nandre *et al*., 2012).

Pongamia (*Pongamia pinnata*). Karanjin is the active principles present in the *P. pinnata,* which shows anti–feedent, Juvenile Hormone Analogue (JHA) and insecticidal activity against insect pests (Vishal Kumar *et al.*, 2006).

Datura (*D. stramonium*). Hyoscyamine, Atropine and Scopolamine are the active principles present in Datura, which show repellent and oviposition deterrent activity against insect pests (Devil *et al.,* 2011).

Lantana (*L. camera*). Lantanolic acid and Lantic acid are the active principles present in Lantana, which shows growth inhibition and repellent activity against insect pests (Nirmal *et al.*, 2009).

Custard apple (*A. squamosa*). Anonaine and squamocin are the active principles present in the *Annona squamosa*, which shows feeding deterrent activity against insect pests (Singh and Saratchandra, 2005)

Nilgiri (*E. globules*). Camphene, Limonene, Alpha & Beta pinenes and Alpha terpienol are the active principles present in Nilgiri globules, which show repellent activity against insect pests (Dhumal and Waghmare, 2014).

Parthenium (*P. hysterophorus*). Parthenin is the active principles present in the Parthenium (Veena and Shivani , 2012) which show feeding deterrent and insect growth inhibitor activity against insect pests (Datta and Saxena, 2001; Pandey 2009).

Conclusion

In recent years the use of synthetic insecticides in crop protection program resulted in disturbances of the environment, pesticide residues, pest resurgence, pest resistance etc. This leads to increased importance to naturally occurring plants associated with rich traditional knowledge base available with the highly diverse indigenous communities in India which is the environmental friendly agricultural technology for ensuring food safety and food security. The current trends of modern society towards Green Consumerism desiring fewer synthetic ingredients may favor plant–based products called Green Pesticides or Botanical Pesticides, Plant Pesticides or Botanicals ecological pesticides which are eco–friendly, biodegradable, natural, no residual effect etc. Therefore, this rich heritage of the botanical knowledge should be harnessed, preserved, documented, and developed as modern science such as Indigenous Integrated Pest Management or Ethno–Botanical Crop Protection.

Acknowledgement

Authors are thankful to the farmers of the study area for sharing the knowledge of indigenous herbal–based pest management practices followed by them. The authors are also thankful to University of Agricultural Sciences Bengaluru, and College of Sericulture, Chintamani for providing an opportunity for taking up this study and guiding us in all the aspects of this study.

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