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SURVEY ON INDIGENOUS FORMULATIONS OF PHYTO-INSECTICIDES

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Abstract

The present survey was an effort to gather Indigenous Technical Knowledge (ITK) used for pest management prevalent among the organic farmers of seven agro climatic zones of Tamil Nadu. The different districts covered were Cuddalore, Salem, Namakkal, Erode, Perambalur, Thirchi, Ariyalur, Thanjavur Madurai, Kanyaumari and Nilgiris. The information was collected on the basis of personal interview from each farmer through a questionnaire. The stakeholders who willingly adopt the techniques shared by organic farmers are not sustainable because there are many unanswered micro level problems. ITK is developed over a long period of use by a specific community by considering local culture and environment on minimizing risk rather than maximizing profit. Having engaged with continuous battle with pests. The highest number of traditional practices was recorded in Cauvery delta zone and of Tamil Nadu and was followed by North West zone. The least number of practices was recorded in Hilly zone. 34 plant and 4 animal products were utilized in various preparation. The 147 practices recorded were thoroughly scrutinized and repetitions were avoided.

Key words : ITK practices, Organic pest management, Botanical insecticides.

Introduction

The improper exercise of insecticides in agriculture has resulted in serious deterioration of agro-eco systems and associated food chain. Overwhelming evidences on structure and activity relationship of some frequently used insecticides also relinquish the risk to life forms and environment. Though modern agriculture with high input and output, improved the affordability of food and ensured food security; sustainability of farming practices with local inputs are faded away. There are numerous definitions for sustainable or organic agriculture, but United States Department of Agriculture defines that "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem, health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs". This knowledge is based on many generations of insight gained through close interaction within the natural and physical microenvironments (Rajasekaran et al., 1991 and Kolawole 2001). ITKs are passed verbally from one generation to the next without having authenticated written documents except a few. Many definitions have been proposed for ITK systems, but all of them are incomplete, because the concept is still evolving. The ITKs are eco friendly and compatible to pest management practices (Deka *et al*., 2006). Mainly ITKs are based on cultural values of the community (Venkata Ramaiah and Rama Raju, 2004). However, a fraction of farming community in Tamil Nadu believed on local inputs in insect pest management programmes and they strongly promote their Indigenous Technical Knowledge (ITK) and their experiences. But the stakeholders who willingly adopt the techniques shared by organic farmers are not sustainable because there are many unanswered micro level problems. ITK is developed over a long period of use by a specific community by considering local culture and environment on minimizing risk rather than maximizing profit. Having engaged with continuous battle with pests. Kalyani and Murugan (2018) categorized the opinions related to organic farming in Tamil Nadu State in to three; the first category plainly rejects the concept, the second group aware of the value and quality and believe that the yields are lower and the third one practices the ITK

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techniques full-heartedly and hope for tomorrow's ecology which is more important than today's farm benefits. The present study targeted the farmers of third group in Tamil Nadu and gathered information on botanicals based traditional insect pest management techniques. Fossil records revealed that the human use of plants as traditional medicine date back to middle Palaeolithic age, approximately 60,000 years ago (Solecki and Shanidar, 1975). More than 250 million indigenous people and more peasant communities throughout the world remains substantially dependant on traditional modes of production of food, fodder, fuel etc. to fulfil their basic requirements. Besides this plants were used as flavours, insect repellent, ornamentals, fumigants, spices and cosmetics (Kunin *et al.,* 1996). Botanical pesticides have a proven track record and long use as simple extractives for pest control and have spun off important groups of synthetic pesticides from phytochemical leads such as pyrethroids and neonicotinoids. (John *et al*., 2012). Although, phyto-insecticides have been used traditionally for generations throughout the world (Belmain *et al.,* 2001), many formulations cited have not given sustainable effects. There is rich knowledge on the use of plants against nuisance insect. However, very little of it has so for been documented. Thus the survey is so important to document existing practices and paved the way for scientific validation.

Materials and Methods

A survey on ITKs related to botanicals in insect pest management was undertaken in all the seven agro climatic zones of Tamil Nadu State from December 2017 to January 2019. In total, 401 organic farmers belonging to 84 villages and 11 districts were interviewed. The districts covered were Cuddalore, Salem, Namakkal, Erode, Perambalur, Trichy, Ariyalur, Tanjavur, Madurai, Kanyakumari and Nilgiris. The interview was based on a standard questioner to the respondents. Information on the details of ingredients, quantity, method of preparation, insect pests controlled number of application and efficacy was gathered.

Result and Discussion

The survey contacted with 401 farmers of 84 villages of 11 districts and seven agro climatic zones *viz.,* North eastern zone, North western zone, Western zone, Cauvery delta zone, Southern zone, High rainfall zone and Hilly zone of Tamil Nadu yielded 147 traditional pest management practices. The highest number of traditional practices was recorded in Cauvery delta zone and of Tamil Nadu and was followed by North West zone. The least number of practices was recorded in Hilly zone (Table 1). 34 plant and 4 animal products were utilized in various preparation (Table 3). The 147 practices recorded were thoroughly scrutinized and repetitions were avoided. Finally 60 practices were fixed for further studies. Among field crops ITK's were followed on paddy, pulses and cotton. More number of ITK's was used on vegetables. Farmers used ITK's against various range of pests. They had ITK's against all the important sucking pests including mites (Table 2). Sucking pests are the major problems nowadays and existing chemical insecticides are not able to manage them. In this situation, these ITK's are getting importance. Scientific validation standardization of formulation will give good product. The earlier survey conducted by Kiruba *et al.*, (2006) showed utilization of only four plants in the Traditional Pest Management practices in Tamil Nadu. Plant belonging to 26 families and animal products such as cow's urine, egg, and butter milk and fish waste were utilized in the preparation of product in Tamil Nadu as per our survey. Regarding the satisfactory level of farmers on the efficacy of ITK's in the field, 6 products were graded as A (High level of satisfaction), 13 and 41 products were graded as B (Medium level of satisfaction) and C (High satisfaction only in some season) respectively. Thus there is a scope for further improvement of formulations. In an attempt to revalidate indigenous pest control practices enliving in certain hillock of Tamil Nadu, showed more than 125 practices towards like Rice, Vegetables, stored product and domestic habitation (Purusothaman *et al.,* 2009). The previous study by Nath *et al.,* (2017) described the ITK of pest management practiced by the farmers of Tinsukia

Table 1: Details of the survey related to botanicals based ITK's of Tamil Nadu.

Agro climatic Zones of Tamil Nadu	Name of the District	No. of contact farmers	No. of Traditional practices Existed
North eastern zone	Cuddalore	45	23
North western zone	Salem, Namakkal	67	28
Western zone	Erode	45	21
Cauvery delta zone	Perambalur,Thirchi, Ariyalur, Thanjavur	175	53
Southern zone	Madurai	46	15
High rainfall zone	Kanyaumari	14	4
Hilly zone	Nilgiris	9	3
7	11	401	147

Table 2: Specifications of botanical based Indigenous practices of Tamil Nadu.

S.No.	Treatment	Composition and quantity/ac		Formulation technique (Diluted in 100L of water)	Crop	Against insect pest	Grade
		Component	Qty				
1.	Herbal insect repellent (*Mooligai poochi virati*)	Green Chirayta leaf	500g	Leaf paste kept in an aluminum vessel (5L capacity) added with Cow's urine, boiled for 20-25 minutes and filtered through muslin cloth.	Black gram	Blister beetle (*Mylabris pustulata*)	A
		Neem leaf	500g				
		Notchi leaf	500g				
		Cow's urine	3L				
2.	Herbal insect repellent (*Mooligai poochi virati*)	Notchi leaf	300g	-do-	Bhendi	Whitefly (*Bemesia tabaci*), Leaf hopper (*Amrasca devastans*)	A
		Neem leaf	200g				
		Tamarind leaf	100g				
		Cow's urine	3L				
3.	Herbal insect repellent (*Mooligai poochi virati*)	Neem leaf	2kg	-do-	Tobacco	Tobacco caterpillar (*Spodoptera litura*), Stem borer (*Scrobip-alpa heliopa*)	A
		Green chilli	500g				
		Garlic	500g				
		Cow's Urine	3L				
4.	Herbal insect repellent (*Bhiramasthiram*)	Green chilli	1kg	-do-	Brinjal	Fruit and shoot borer (*Leucinodes orbonalis*), Hadda beetle (*Henosepila-chna viginctioctop-unctata*)	B
		Neem leaf	2kg				
		Cow's urine	5L				
5.	Herbal insect repellent (*Agni asthiram*)	Green chilli	300g	-do-	Bhendi	Shoot and fruit borer *(Earias vittella)*	B
		Garlic	300g				
		Neem leaf	300g				
		Cow's urine	3L				
6.	Herbal insect repellent (*Agni asthiram*)	Notchi leaf	500g	-do-	Green gram, Black gram	Gram pod borer (*Helicoverba armigera*), Spotted pod borer (*Maruca testulalis*), Pod fly (*Melanagromyza obtusae*)	B
		Neem leaf	500g				
		Green chilli	500g				
		Water	3L				
7.	Herbal insect repellent (*Agni asthiram*)	Geen chilli	1kg	-do-	Cotton	Spotted bollworm (*Earias vitella*) Red cotton bug (*Dysdercus cingulatus*)	C
		Cow's urine	3L				
8.	Herbal insect repellent (*Vetrilai vaithiam*)	Betel vein leaves	200g	-do-	Cotton	Spiny bollworm (*Earias insulana*), Red cotton bug (*D. cingulatus*)	C
		Cured tobacco	500g				
		Calcium carbo.	200g				
		Water	5L				
9.	Herbal insect repellent (Five leafextract)	Neem leaf	500g	-do-	Brinjal	Ash weevil (*Myllo-cerus subfasciatus*)	A
		Notchi	500g				
		Worm killer	500g				
		Crown Flower	500g				
		Coccinia leaf	500g				
		water	5L				
10.	Neem seed extract	Neem seed powder	1Kg	Neem seed powder was soaked in water for 24h. and filtered through muslin cloth.	Jasmine	Eriophid mite (*Aceria cajani, Hendecasis*)	B
		water	3L				

Table 2 contd.....

Table 2 contd.....

S.No.	Treatment	Composition and quantity/ac		Formulation technique (Diluted in 100L of water)	Crop	Against insect pest	Grade
		Component	**Qty**				
11.	*Moringa oleifera* leaf extract	Moringa leaf paste	1Kg	Moringa leaf paste kept in aluminum vessel (5L capacity) added with water was added to the past. The solution was boiled for 35 to 40 minutes and filtered through muslin cloth.	Chilli, Red gram	Thrips(*Scirtothrips dorsalis*), Mite (*Polyphagotarsonemus latus*) Pod fly (*Melanagromyza obtusae*), Leaf cutter bee (*Megachile anthracina*)	*B*
		Water	3L				
12.	*Moringa oleifera* leaf & bark extract	Moringa leaf paste	1Kg	-do-	Ridge gourd	Pumpkin beetle (*Aulacophora foveicollis*), Pumpkin caterpillar (*Diaphania (Eudioptes) indica*)	B
		Moringa bark paste	1Kg				
		Water	5L				
13.	*Moringa oleifera* bark extract	Moringa bark paste	1 Kg	-do-	Ridge gourd, Brinjal	Pumpkin beetle (*A. foveicollis*) Dusky cotton bug (*Oxycarenus hyalinipennis*)	C
		Water	3L				
14.	*Pedalium murex* plant extract using rice fermented water	Bara Gokhru whole plant	1 Kg	The *whole* plant of Bara Gokhru was stride in to rice fermented water for 10 minutes and then filtered through muslin cloth.	Red gram, Amaranthus	Pod fly (*G. distigma*)Amaranthus caterpillar (*H. recurvalis*)	*C*
		Rice fermented water	5Kg				
15.	*Pedalium murex* plant extract	Bara Gokhru whole plant	1kg	-do-	Rose	Thrips (*R. ruentatus*) Leaf cutter bee (*M. anthracina*)	*C*
		water	3kg				
16.	*Leucas aspera* plant extract	Common leucas whole plant	1 Kg	Whole plant paste kept in an aluminum vessel (5L capacity) and added with water. The solution was filtered through muslin cloth.	Chilli	Thrips (*S. dorsalis*), Mite (*P. latus*)	C
		water	3L				
17.	*Phyla nodiflora* plant extract	Bara Gokhru plant	1 Kg	-do-	Chilli, Rose Thrips	(*S. dorsalis*), Mite(*P. latus*) Rose aphids (*M. rosaeformis*)	C
		water	3L				
18.	*Eclipta porstrate* plant extract	False daisy whole plant	3 Kg	-do-	Amaranthus	Amaranthus caterpillar (*H. recurvalis*)	C
		water	5L				
19.	*Andrographis paniculata* plant extract	Green chirayta whole plant	1 Kg	-do-	Paddy, Cabbage	Rice ear head bug (*L. acuta*)Dimont back moth (*Plutella xylostella)*,Mustard aphis (*Lipaphis erysimi*)	C
20.	*Eichhorania crassipes* plant extract	Water hyacinth plant	1 Kg	-do-	Brinjal, Paddy	Ash weevil (*M. subfasciatus*)Rice ear head bug (*L. acuta*)	C
		water	1 L				

Table 2 contd.....

Table 2 contd.....

S.No.	Treatment	Composition and quantity/ac		Formulation technique (Diluted in 100L of water)	Crop	Against insect pest	Grade
		Component	Qty				
21.	*Catharanthus roseus* plant extract	Rosy periwinkle plant	1 Kg	-do-	Paddy, Rose	Leaf folder (*Cnaphalocrocis medinalis*) Rose aphids (*Macrosiphum rosaeformis*), Thrips (*R. cruentatus*)	C
22.	*Cascabeal thevetia* fruit extract	Lucky nut fruit	1 Kg	-do-	Onion, potato	Onion fly (*Delia antique*),Thrips (*Thrips tabaci*) Cutworm (*Agrotis ipsilon)*	C
		water	10L				
23.	*Cascabela thevetia* fruit extract using Cow's urine	Lucky nut fruit	1 Kg	-do-	Paddy	Case worm (*Para-poynx stagnalis*), Green horned caterpillar (*Melani-tis leda ismene*)	C
		Cow's urine	10L				
24.	*Tridax procumbens* powder	Coat buttons powder	500g	-do-	Bitter gourd	Hadda beetle (*H. viginctioctopunctata*)	*C*
		Water	5L				
25.	*Cleistanthus collinus* leaf extract	Nilaippalai leaf	1 Kg	-do-	Black gram	Aphids (*Aphis craccivora*) Hadda beetle (*H. viginctioctopunctata*)	*C*
		Water	5L				
26.	Turmeric powder & Calcium carbonate extract	Turmeric powder	500g	Turmeric powder & $CaCo_3$ soaked in water for 12h filtered through muslin cloth.	Black gram, Green gram	Aphids (*A.craccivora*) Hadda beetle (*H. viginctioctopunctata*) Thrips (*R. cruentatus*)	C
		Calcium carbonate powder	1 Kg				
		Water	10L				
27.	*Acorus calamus* powder dust	Sweet flag powder	2 Kg	Sweet flag powder mixed with sand.	Green gram	Spotted pod borer (*M. testulalis*)	A
		Sand	10 kg				
28.	Turmeric Powder extract	Turmeric Powder	200g	Powder kept in an aluminum vessel (5L capacity) added the solution was boiled for 10 to 15 minutes and filtered through muslin cloth.	Cabbage	Mustard aphis (*Lipaphis erysimi*), Flea beetle (*Phyllo-treta vittula*), Tobacco caterpillar (*S. litura*) Aphids (*A. craccivora*)	C
		water	3L				
29.	Clove powder	Clove powder	100 g	Clove powder and salt mixed with cow's urine and filtered through muslin cloth.	Cauliflower	Mustard aphis (*Lipaphis erysimi*), Flea beetle (*P.vittula*)	C
		salt	100g				
30.	*Acorus calamus* extract	Sweet flag powder	500g	-do-	Bitter gourd	Mealy bug (*M. hirsutus*)	C
		Cow's urine	3L				
31.	Chilli extract using cow's urine	Chilli powder	300g	-do-	Chrysanthe-mum	Black aphids (*M.sanborni*), Composite thrips (*M. abdominalis*) Mite (*P. latus*)	C
		cow's urine	3L				

Table 2 contd.....

Table 2 contd.....

S.No.	Treatment	Composition and quantity/ac		Formulation technique (Diluted in 100L of water)	Crop	Against insect pest	Grade
		Component	Qty				
32.	Ginger, garlic & green chilli extract	GingerPaste	100g	Paste of the ingredients boiled in water and filtered through muslin cloth and soap oil and added with neem oil mixture.	Chilli	Thrips (*S. dorsalis*)	B
		Garlic paste	100g				
		Green chilli paste	100g				
		Neem oil	50ml				
		Soap oil	50ml				
33.	Green chilli Extract of rice porridge	Green chilli paste	500g	Green chilli paste added with rice gruel.	Chilli	Thrips (*S. dorsalis*) Mite (*P. latus*)	C
		Rice porridge	2L				
34.	Ginger, garlic & Green chilli extract using cow's urine	Ginger paste	500g	-do-	Paddy	Rice ear head bug (*L. acuta*)	B
		Garlic paste	400g				
		Green chilli paste	600g				
		cow's urine	5L				
35.	Ginger & garlic extract	Ginger paste	400g	-do-	Paddy, Amara-nthus	Grasshopper *(H.banian)* Grasshopper (*A.crenulata*)	B
		Garlic paste	200g				
		water	3L				
36.	Neem & pungam oil	Neem oil	300ml	Mixing of neem oil with pungam oil and then with soap oil.	Curry leaf	Psyllid bud (*Diaphorina citri*)	B
		Pungam oil	200ml				
		Soap oil	100ml				
37.	Neem oil	Neem oil	300ml	-do-	cotton	Whitefly (*B.tabaci*), Leaf hopper (*A. devastans*)	C
		Soap oil	50ml				
38.	Neem oil & Chilli powder	Neem oil	300ml	-do-	Tobacco	Tobacco caterpillar (*S. litura*),Stem borer (*S. heliopa*)	C
		Chilli powder	100g				
		Soap oil	50ml				
39.	Neem, Pungam & *Mahua longifolia* oil	Neem oil	100ml	-do-	Brinjal	Fruit and shoot borer (*L. orbonalis*), Hadda beetle (*H. viginctioc-topunctata*), Ash weevil (*M.subfasciatus*)	B
		Pungam oil	100ml				
		Iluppai oil	100ml				
		Soap oil	100ml				
40.	*Aloe vera* extract	*Aloe vera leaves*	10 no.	*Aloe vera* leaves pounded with water and filtered through muslin cloth.	Red gram	Gram pod borer (*H. armigera*)	C
		Water	5L				
41.	*Datura metel* fruit extract	Metel fruit paste	1kg	Metel fruit paste boiled in cow's urine for 20 min. and filtered through muslin cloth.	Cotton	Spotted bollworm (*E. vitella*) Red cotton bug (*D. cingulatus*) Spiny bollworm (*E. insulana*), Red cotton bug (*D. cingulatus*)	C
		Cow's urine	3L				
42.	*Datura metal* leaf extract rice porridge	Metel leaf extract	1kg	-do-	Jasmine	Eriophid mite (*A.cajani)*	C
		Rice porridge	3L				
43.	*Prosopis juliflora* leaves & gum extract	Algaroba Leaves	1kg	-do-	Chilli, Green gram	Thrips(*S. dorsalis*), Mite (*P. latus*) Gram pod borer (*H. armigera*)	C
		Algaroba gum	500g				
		Water	3L				
44.	*Ailanthus excelsa* leaf extract	Heaven leaf	1kg	-do-	Bitter gourd	Spotted pod borer (*M. testulalis*) Pumpkin beetle (*A. foveicollis*),	C
		water	3L				

Table 2 contd.....

Table 2 contd.....

S.No.	Treatment	Composition and quantity/ac		Formulation technique (Diluted in 100L of water)	Crop	Against insect pest	Grade
		Component	Qty				
						Pumpkin caterpillar (*Diaphania (Eudioptes) indica*)	
45.	*Albizia amara* leaf extract	Oil cake tree leaf	1 Kg	-do-	Cucumber	Pumpkin beetle (*A. foveicollis*)	C
		Water	5L				
46.	*Lawsonia inermis* leaf extract	Henna tree leaf	1kg	-do-	Amaranthus	Amaranthus caterpillar (*Hymenia recurvalis*)	C
		water	10L				
47.	*Phyla nodiflora* extract	Frog fruit leaves	1kg	-do-	Rose Thrips	(*Rhipiphorothrips cruentatus*) Leaf cutter bee (*Megachile anthracina*)	*C*
		water	5kg				
48.	*Cyperus rotundus* & *Cynodon dactylon* extract	Nut grass	1kg	-do-	Chilli Thrips	(*S. dorsalis*), Mite (*Polyphagotarsonemus latus*)	C
		Bermuda Grass	1kg				
		water	3L				
49.	Tobacco extract	Cured Tobacco leaf	500g	-do-	Rose	Rose aphids (*M. rosaeformis*)	C
		water	3L				
50.	Tobacco extract using cow's urine	Cured Tobacco leaf	500g	-do-	Cabbage	Mustard aphis (*Lipaphis erysimi*), Flea beetle (*Phyllotreta vittula*), Tobacco caterpillar (*Spodoptera litura*)	B
		Cow's urine	3L				
51.	Notchi, neem & green chilli extract	Notchi leaf	500g	-do-	Cabbage, cauliflower	Dimont back moth (*Plutella xylostella)*, Mustard aphis (*Lipaphis erysimi*)	A
		Neem leaf	400g				
		Green chilli	300g				
		water	10L				
52.	*Coccinia grandis* extract	Coccinia vein	1kg	-do-	Rose	Rose aphids (*Macrosiphum rosaeformis*), Thrips (*Rhipiphorothrips cruentatus*)	*C*
		Cow's urine	5L				
53.	Rice porridge	Rice porridge	3L	Rice gruel and cow's urine was added. Then, it is fermented for 15 days.	Onion	Onion fly (*Delia antique*),Thrips (*Thrips tabaci*)	
		Cow's urine	3L				
54.	Butter milk	Curd	1L	1 kg curd added with 5L of water.	Cucumber	Cutworm (*Agrotis ipsilon)*	C
		Water	5L				
55.	Broiler Eggs extract	Broiler egg	5 no	Egg yolk added with lemon juice and fermented for two weeks and added with water.	Paddy	Case worm (*Parapoynx stagnalis*), Green horned caterpillar (*Melanitis leda ismene*)	*C*
		Lemon	10 no.				
		Water	5L				
56.	Fish amino acid	Fish waste	1kg	Fish waste and jaggery kept in plastic container (5L. capacity) thoroughly mixed with using wooden rod and fermented for 15 days.	Paddy, Amaranthus	Grasshopper *(Hieroglyphus banian)* Grasshopper **(***Atractomorpha crenulata***)**	*B*
		Jaggery	1kg				
		Water	3L				
57.	Onion & garlic peels extract	Onion peels	200g	Peels of onion & garlic soaked in cow's urine	Rose	Thrips (*Rhipiphorothrips cruentatus*)	C
		Garlic peels	200g				

Table 2 contd.....

Table 2 contd.....

S.No.	Treatment	Composition and quantity/ac		Formulation technique (Diluted in 100L of water)	Crop	Against insect pest	Grade
		Component	Qty				
		Cow's urine	3L	for 3 days and filtered through muslin cloth.			
58.	Calcium carbonate water	Calcium stones	1kg	Calcium stones soaked in water for overnight and added to turmeric powder and filtered through muslin cloth.	Cabbage, Cauliflower	Mustard aphis (*Lipaphis erysimi*), Flea beetle (*Phyllotreta vittula*), Tobacco caterpillar (*Spodoptera litura*)	C
		Turmeric powder	200g				
		Water	10L				
59.	Onion extract	Onion paste	500g	Onion paste boiled with water and filtered through muslin cloth.	Paddy	Rice ear head bug (*Leptocorisa acuta*)	C
		water	5L				
60.	Banana pseudo stem extract	Banana pseudo stem	5kg	Ingredients made into paste mixed with Cow's urine and fermented for 15 days.	Chrysanthemum	Black aphids (*M. sanborni*), Composite thrips (*M abdominalis*)	C
		Fish waste	2kg				
		Jaggery	2kg				
		Cow's urine	50L				

Grade A	High satisfaction related to efficacy
Grade B	Medium Satisfaction related to efficacy
Grade C	High satisfaction only in some seasons

districts of Assam. A total sample of 200 farmers of twenty different villages was selected randomly from three rural developmental blocks of the district and 30 ITKs were collected and documented. A total of 80 plants belonging to 39 families have been documented for their insecticidal and pesticidal potential by Dhale (2013). Kapil Kumar *et al*., (2017) surveyed the indigenous technical knowledge (ITK) used for tea pest management prevalent among the small tea growers of different districts of Assam *viz*. Tinsukia, Dibrugarh, Sivasagar, Jorhat, Golaghat, Nagoan, Sonitpur and Lakhimpur. He concluded that the ingredients used were available locally in abundance made from either plant or animal product. The tea growers were using those traditional practices to control pests like red spider mite (*Oligonychus coffeae*), tea mosquito bug (*Helopeltis theivora*) and looper caterpillar (*Buzura suppresseria*).

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Reference

Arnason, J.T., S.R Sims and I.M. Scott (2012). Natural products from plants as insecticides. Encyclopedia of Life Support Systems (EOLSS).1-8.

Belmain, S.R., G.E. Neal, D.E. Ray and P. Golob (2001). Insecticidal an vertebrate toxicity associated with ethnobotanicals used as post- harvest protectants in Ghana. *Food Chem. Toxicol*., **39:** 287-291.

Bhuyan, K.K., G.K. Saikia, M.K. Deka, B. Phukan and S.C. Barua (2017). Traditional tea pest management practices adopted by small tea growers of Assam. *Journal of Entomology and Zoology Studies,* **5(2):** 1338-1344.

Deka, M.K., M. Bhuyan and L.K. Hazarika (2006). Traditional pest management practices of Assam. *Indian J. Traditional Knowledge,* **5(1):** 75-78.

Dhale, D.A. (2013). Plants Used for insect and pest control in North Maharashtra, India. *The Journal of Ethnobiology and Traditional Medicine*, 379 -388.

Kalyani, V. and K.R. Murugan (2018). Organic farming in Tamil Nadu: Status, Issues and Prospects. *American International Journal of Research in Humanities, Arts and Social Sciences*, **21(1):** 82- 86.

Kiruba, S., S. Jeeva and S.S.M. Dhass. Enumuration of ethnoveterinary plant of cape comorin, Tamil Nadu. *Indian J. Traditional Knowledge*, **5(4):** 576-578.

Kolawole, O.D. (2001). Local knowledge utilization and sustainable rural development in the 21st century. Indigenous Knowledge Develop. *Monitor*, **9(3):** 13-15.

Kunin, W.E., J.H. Lawton (1996). Does biodiversity matter? Evaluating the case for conserving species. In: Biodiversity, (Editor Gaston, K.J.), Blackwell Science LTD, UK. 283-308.

Nath, R.K., P. Ahmed and A.C. Sarmah (2017). Indigenous

Technological Knowledge (ITK) for pest management in Tinsukia district of Assam. *Indian J. Traditional Knowledge,* **12(1):** 1-3.

Purusothaman, M., N. Ponnarasan and P. Narayanasamy (2006). Traibal pest control practices of Tamil Nadu Sustainable agriculture. *Indian J. Traditional Knowledge,* **8(2):** 218-224.

Rajasekaran, B.D., D.M. Warren and S.C. Babu (1991). Indigenous natural resource management systems for sustainable agriculture development - A global perspective. *J. Internat. Develop*., **3(4):** 387- 401.

Solecki, R. and I.V. Shanidar (1975). A Neanderthal flower burial in northern Iraq. *Science*, **190:** 880-881.

Venkata Ramaiah, P. and K.V. Rama Raju (2004). Blending of Indigenous Technologies with judicious use of external inputs for sustainable agriculture paper Peoples Wisdom. Gosh, S.N (ed.). National Council of Development Communication, Sundarpur, Varanasi, 249-253.