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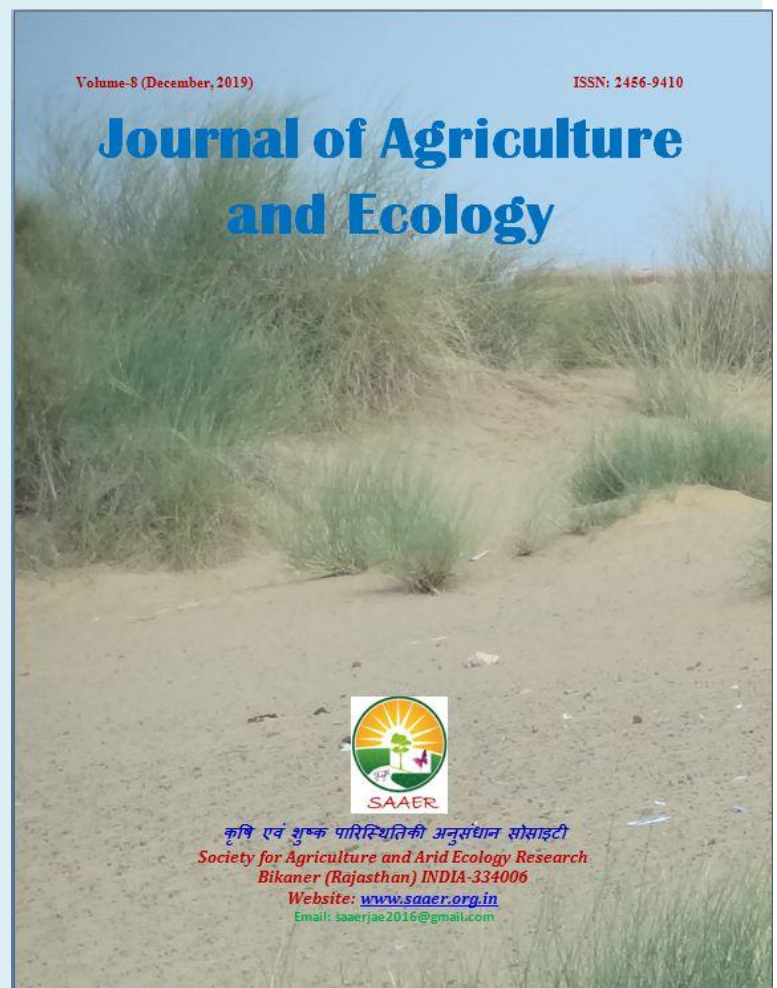
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ITK adoption pattern of organic farming in Tamil Nadu for the management of shoot and fruit borer, *Leucinodes orbonalis* Guenee in brinjal crop

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Abstract

Brinjal, *Solanum melongena* L, is a commercial grown vegetable crop cultivated by the farmers since several years. Farmers rely mainly on pesticides for the management of *L. orbonalis*, one of the major destructive pest of brinjal. The awareness among the farmers is increasing day by day for organic farming and organic produce, the area under organic farming is in expanding stage in different state in India. The present study was taken to document and to understand the ITK practices of farmers growing organic brinjal in different districts in Tamil Nadu. Majority of the farmers 65.42 per cent who are practicing farmers are medium category land holding of 2 to 10 hectare and 86.70 per cent of farmers interview depend organic agriculture as main source of Income. Use of 14 different soil amendments/ foliar spray to meet out the nutrient requirement of the organic brinjal crop. The cow based ITK product *Panchagavya* is a major source of nutrient substitute used by 73 percent of the farmers. They use around 14 different ITK concoctions in rotation for the management of *L. orbonalis*. Most commonly used ITK concoctions were *Meenamulam* (10 ml /lit),Neem oil (2ml/ lit), Ginger-Garlic extracts (5ml/ lit), Ten leaf extract (16.4%) *moor karaisal* (100ml/ lit) *pungam* oil (30ml/lit), tobacco leaf extract (30ml / lit) *Agniasthiram* (30ml/ lit) and *Neemastram* (25ml/ lit). A *Meenamulam* ITK concoctions used by 75 per cent of the farmers across the Tamil Nadu. The present study indicates availability of an array of ITK concoctions used by the organic farmers for the management of *L. orbonalis* in brinjal. The information generated in the present study will be useful in designing organic IPM module for the pest management in brinjal and organic vegetable cultivation in general.

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Introduction

Brinjal (*Solanum melongena*), also known as eggplant or aubergine belonging to the family Solanaceae, is one of the common and popular vegetables grown throughout the world including India. The origin of brinjal is claimed to be South-East Asia, probably India and the crop is extensively grown in France, Italy and Europe (Salunkhe et al. 1987). The brinjal crop is considered as cash crop vegetable by small and marginal farmers and it gives income in alternate days for cash income. In the state of Tamil Nadu, production area for brinjal crop has increased from (12323 to 12515 MT) in 2016-2017 (Anon 2018). According to the Atwal & Dhaliwal (2005), the pest is widely distributed in Malaysia, Myanmar, Sri Lanka, India, Pakistan, Germany and East Africa. The yield loss varies with different environmental conditions but can cause yield loss up to 70-92 per cent (Adiroubane et al. 2008). The affected fruits are not used for consumption due to loss of market value and quality. The yield loss by this pest quantified to varied from 0.08 to 1.11 quintal / ha on the basis of inconsumable pest of damaged fruits and 0.46 to 3.80 quintal / ha (Ashadul et al. 2014).

Though brinjal is a major vegetable crop and the brinjal shoot and fruit borer is of severe problem in many parts of the world, the management option to combat BSFB is limited to discriminate use of chemical pesticides making cultivation expensive and reduction in quantity of marketable yield (Forrester 1990). The over use or misuse of insecticides leads the insect tolerant to chemical pesticide and making it difficult to

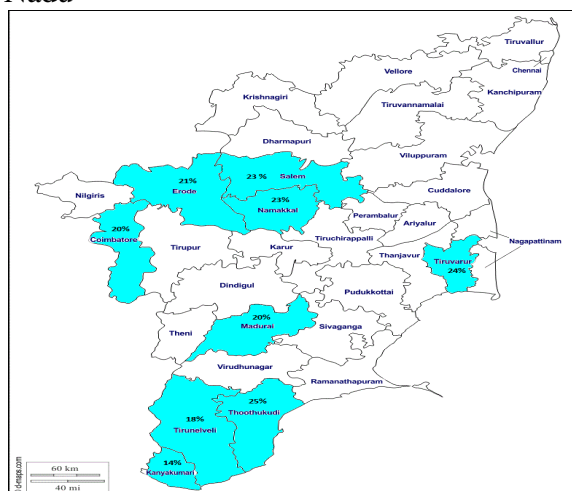
manage. Besides, residue in produce and environmental and human contamination (Kalawate & Dethe 2012) with increasing awareness on pernicious consequences of over dependence on chemical insecticides, use of alternative strategies for the management of BSFB become imperative. The conventional non-chemical methods viz., use of plant products, cultural practices like hoeing, intercropping, clipping damaged shoots and fruits and weeding, inundative release of bio control agents like *Trichogramma* egg parasitoid, use of sex pheromone traps are being recommended as integrated method in IPM. Organic farming in agriculture is an emerging concept in crop cultivation in Tamil Nadu during 2017-2018 and there were 30,910 acres cultivable land in the state which has been registered for organic certificate under the Tamil Nadu Organic Certification Department (TNOCD), State Department of Agriculture, Tamil Nadu. At national level, there is a greater awareness on organic farming in the states of Andhra Pradesh, Kerala and West Bengal. The Sikkim state is the first state in India to go 100 percent organic agriculture. In our present study, attempts were made to document various pest management practices followed by the organic farmers especially ITK technique so that the same can be further validated and fine tuned for promotion in IPM packages for the organic farming and vegetable cultivation in particular.

Materials and Methods

Survey and documentation of indigenous technical knowledge (ITK) practices of organic brinjal farmers in Tamil Nadu

In order to understand the pest management practices followed by the organic farmers in Tamil Nadu, a survey was conducted using questionnaires. The questioner was designed in consultation with extension scientist and the officials of Tamil Nadu Organic Certification Department (TNDOD), Department of Agriculture, Tamil Nadu so that all the required information is documented. Before going for the survey, the questionnaire was pre-tested with few selected organic farmers in Tirunelveli district and extension scientists of the institute and required modifications were made. There were 188 farmers representing nine districts in Tamil Nadu viz., Tirunelveli, Namakkal, Thiruvarur, Madurai, Thoothukudi, Salem, Kanyakumari, Coimbatore and Erode were interviewed. The farmers were selected based on the inputs from respective district Agricultural Department officials and the local organic farmers association. The information on the number of farmers representing different districts is furnished in Figure 1.

Figure 1. Sample distribution of organic brinjal farmers in different districts in Tamil Nadu



Keeping in view the pest management practices followed for the management of shoot and fruit borer problem in organic brinjal concoction, the questioner was designed with three major parts. In part I, General information about the farmer viz., Name, Address, Age, Education qualification, Family particulars, Agencies in contact, Media sources for crop protection information etc. were collected. In part II, details related to farming like size of land holding, crops cultivated, sources of irrigation were documented. In part III, various practices followed in organic farming like nutrient management, pest and disease management, awareness on use of non-chemical tools in IPM like use of traps, use of augmentatory or conservatory bio control approaches, use of adjuvants in organic sprays, Sprayer, Quantity of spray, Procedure followed in preparing organic concoctions, Special training taken, Source of inspiration.

From each district around 20 farmers who were growing brinjal crop were interviewed and the farmers were chosen based on reference from TNCOD and the local organic farmers association. The interview was conducted by interrogating the farmers individually through either personal farms visits or by telephone contacts depending on their accessibility.

Results and Discussion

The survey was conducted during December, 2017 to February, 2018 *rabi* season with standard questionnaire to access the Organic ITK Concoctions usage pattern

and extent of ITK adoption. Number of farmers represent in of namely Coimbatore, Erode, Madurai, Kanyakumari, Salem, Thiruvavarur, Thoothukudi and Tirunelveli.

Demography and Socioeconomic characteristics of the organic Brinjal Farmers

In terms of education level, the farmers were categorized into four groups such as non-educated and education of primary level (up to class five), secondary level (class six to ten) and above secondary level. Among the farmers 16.4 per cent of the farmers practicing organic farming were illiterate and (33.5%) of the farmers are of the primary level educated, while a majority of 35 per cent surveyed were secondary level have education and 15 per cent are educated above secondary level. In terms of land holding most of them are medium category farmers having land holding between 2 to 10 ha acre who represented 65.42 per cent of the farmers studied. A small portion of the organic farmers (2%) involved in organic farming who marginal farmers are having the land holding a land area of less

than one hectare. About 6.3 per cent of small farmers having land holding between one hectare to two hectares. Around 26.5 per cent of the farmers surveyed are having more than 10 ha (large farmers). Majority of the farmers interviewed (86.7%) depends organic farming as their sole profession whereas 13.2 percent of them farmers were having other business along with organic farming. Majority of the farmers involved in organic farming are (77.6 %) of middle age having less than 25 years of experience and 15.9 per cent of them are having 25 to 40 years farming experience. Farmers having more than 40 years of experience representing only 6.3 per cent. Information gathered on social participation of the organic farmers revealed majority of them (43%) are members in Tamil Nadu Organic Certificate Department (TNOCD) and seven percent were in association with Nammalvar Organic Agriculturist Association of Tamil Nadu. Few farmers were members of Paddy Growers Association and FIG Farmers Association. Majority of the organic farmers were having organic farming in their own land (90.40%) furnished in Table 1.

Table 1. Socio economic characteristics of the organic brinjal farmers in Tamil Nadu

S. No.	Particulars	No. of farmers	Composition Percentage (%)
I	Education (years of schooling)		
1.	Illiterate	31	16.4
2.	Primary school	63	33.5
3.	Secondary level	66	35.1
4.	Above secondary level	28	15
II	Category of farmers based on farm size (ha)		
1.	Marginal (less than 1 ha)	3	2
2.	Small (1 to 2 ha)	12	6.3
3.	Medium (2 to 10 ha)	123	65.42
4.	Large (more than 10 ha)	50	26.5
III	Source of income		



1.	Agriculture	163	86.7
2.	Agriculture /Other business	25	13.2
IV	Farming experience		
1.	1-25 years	146	77.6
2.	25-40 years	30	15.9
3.	40-70years	12	6.3
V	Social participation		
1	Tamil nadu Organic Certificate Department(TNOCD)	81	43
2.	Nammalvar Organic Agriculturalist	13	7
3.	Paddy Growers Association	2	1.0
4.	Fig Farmers Association	2	1.0
VI	Land holding		
1.	Owned	170	90.4
2.	Leased	18	9.50

Status of ITK awareness among the Organic Brinjal Farmers

The data compiled on the ITK practices followed the farmers in brinjal cultivation is furnished in Table 2. It is interesting to note that around 35 percent of them are in contact with local extension officers (Agricultural Officers) mainly to get details on various schemes available in support of organic farming. The district level scientists are being consulted for organic IPM package by 25.50 per cent of the farmers interviewed. Local KVK Subject Matter Specialists involve (SMS) are known to involve them in field level demonstration and training in organic farming. The organic farmers also get ITK known how through farmers to farmers contact to an extent of 13.20 percent. The farmers also have access to the Assistant Agricultural Officer (12.30 %) and also to the district level officers (4.25 %) like Joint Director of Agriculture. Whatsapp groups are also being used for sharing information's mainly on technique, success stories and market intelligence.

Table 2. Status of ITK awareness among the organic brinjal farmers

Category	No. of Farmers	Per cent share
Joint		
Director of Agriculture	8	4.25
Assistant Director of Agriculture	18	9.57
Officer	66	35.0
Assistant Agriculture Officer	23	12.3
Scientist / Krishi Vigyan Kendra	48	25.5
Farmers to farmers	25	13.2

Organic IPM- package adoption pattern of the organic brinjal farmers

Information gathered for the purpose of ascertaining use of organic farming packages like in tentative release of *T.chilonis* egg parasitoid light trap and sex pheromone

trap that were recommended by the university by the farmers who are practicing the organic farming are furnished in Table 3. It is interesting to note that 28 per cent of the farmers surveyed, they also depend on their own organic ITK concoctions beside and adopting external inputs like Trichogramma, pheromone trap and light trap. That are recommended by the agricultural university. Around 136 farmers surveyed are not using any of the external inputs except for the organic ITK concoctions which they prepare their own. The proportion of the farmer surveyed purely depend on traditional organic farming practices and not willing to use improved organic practices recommended by university is up to 72 per cent.

Table 3. Organic IPM –Package adoption pattern of the organic brinjal farmers of Tamil Nadi

Category	No. of Farmers	Per cent
A) Usage of ITK practices + egg Parasitoids and Pheromone traps	52	28
B) Use of Organic products alone (Panchagavya, Jeevamirtham, Amirthakaraisal)	136	72

Status of ITK based organic Concoctions used pattern of organic brinjal farmers

The data collected on organic ITK concoctions used by the farmers in pest management in brinjal cultivation in different districts are furnished in Table 4 and Figure 2. It is observed that the farmers use around 14 different range of organic ITK preparation for pest management in organic brinjal

cultivation. *Meenamulam* is being predominantly used by 75 per cent of the farmers surveyed in all the nine districts and the organic ITK concoctions wise at the rate of 10 ml per liter of spray fluid. Neem oil (2 ml/ lit), *Agniasthiram* (30 ml/ lit) and *Neemastram* (25 ml/ lit) are the other three organic ITK concoctions popular among the farmers in all the nine districts surveyed. The extent of usage of individual product among the farmers surveyed was 50 per cent for Neem oil, 49.46 per cent for *Agniasthiram*, 27.12 per cent for *Neemastram*. Around 17.5 per cent of the farmers representing Kanyakumari, Madurai and Tirunelveli districts are using Ginger-Garlic extracts (5 ml/ lit). Ten leaf extract is another popular organic ITK concoctions (16.4%) among the farmers in Tirunelveli, Salem, Erode, Kanyakumari and Namakkal districts. Organic farmers in Kanyakumari, Madurai, Coimbatore and Thoothukudi are also using Vasambu powder in *L. orbonalis* management. Muttai karaisal, an egg based preparation (2 ml/ lit) and moor karaisal, buttermilk based preparation being used at the rate of (100 ml/ lit) used by 8 per cent of the farmers surveyed. The farmers in Kanyakumari, Tirunelveli, Madurai, Coimbatore also uses pungam oil (30 ml/ lit) and the extent of usage of pungam oil in *L.orbonalis* management is 3.72 per cent. About 3.10 per cent of the farmers representing Kanyakumari districts are also using tobacco leaf extract at (30 ml/ lit).

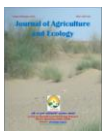
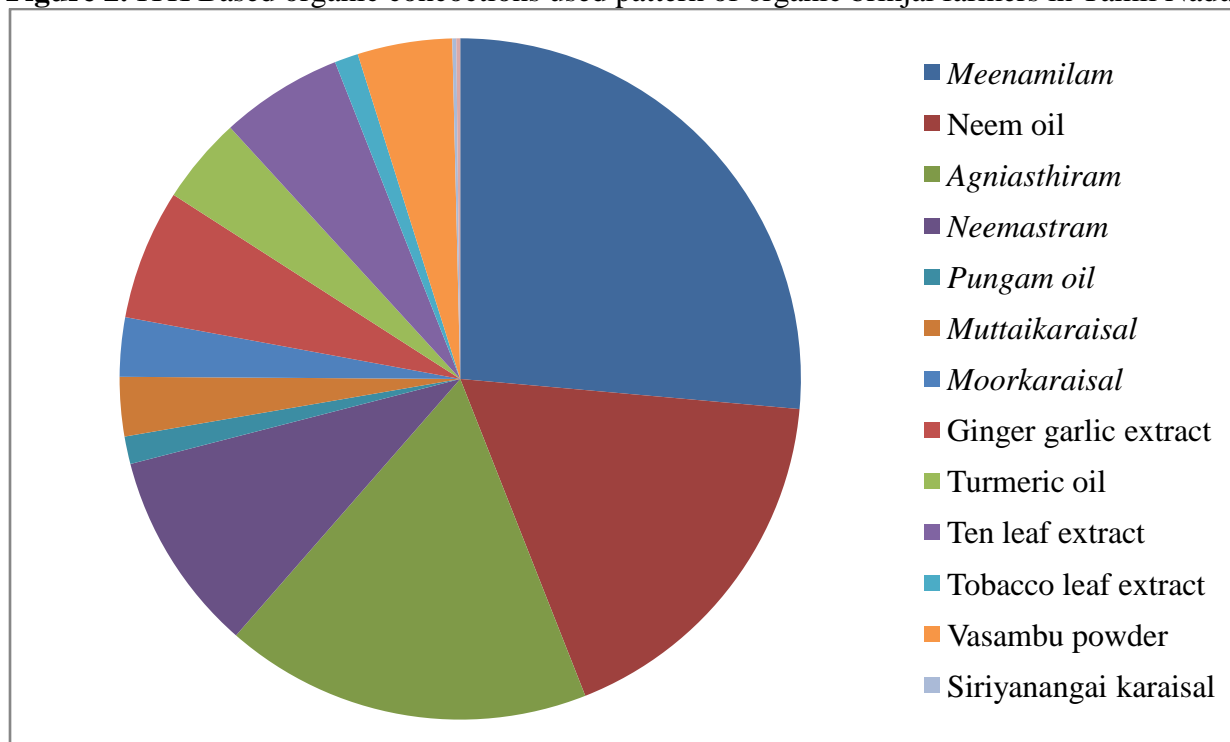


Table 4. ITK based organic concoctions use pattern of organic brinjal farmers in different districts of Tamil Nadu

S. No	Organic Products	Dose	No. of Farmers	Coimbatore	Madurai	Tirunelveli	Thoothukudi	Salem	Erode	Thiruvavur	Namakkal	Kanya kumari	% of use
1.	<i>Meenamulam</i>	10ml/lit	141	18	20	15	18	8	13	17	12	20	75
2.	Neem oil	20ml/lit	94	5	19	5	12	10	7	13	20	3	50
3.	<i>Agniasthiram</i>	30ml/lit	93	10	14	12	14	5	5	10	3	20	49.46
4.	<i>Neemastram</i>	25ml/lit	51	4	5	8	9	2	8	4	5	6	27.12
5.	Pungam oil	30ml/lit	7	1	2	1	-	-	-	-	-	3	3.72
6.	Muttaikaraisal	2ml/lit	15	4	-	3	-	-	3	-	-	5	7.97
7.	Moorkaraisal	100ml/lit	15	-	-	3	-	3	1	-	2	6	7.97
8.	Ginger garlic extract	50ml /lit	33	-	20	3	-	-	-	-	-	10	17.55
9.	Turmeric oil	10ml/lit	22	6	-	4	3	2	1	-	-	6	11.7
10.	Tenleaf extract	30ml/lit	31	-	-	10	-	1	3	-	2	15	16.48
11.	Tobaccoleaf extract	30ml/lit	6	-	-	-	-	-	-	-	-	6	3.19
12.	Vasambu powder	30ml/lit	24	10	1	-	3	-	-	-	-	10	12.76
13.	Siriyanangai karaisal	100ml/lit	1	-	-	1	-	-	-	-	-	-	0.53
14.	Tulasi karaisal	100ml/lit	1	-	-	1	-	-	-	-	-	-	0.53

Figure 2. ITK Based organic concoctions used pattern of organic brinjal farmers in Tamil Nadu



Status of Nutrient Management Practices Adopted By Organic Brinjal Farmers

Details on the nutrient management practices adopted in organic cultivation of brinjal in Tamil Nadu are furnished in Table 5 and Figure 3. There were a total of 14 different nutrient substitutes being used in organic brinjal cultivation which includes four conventional preparations like farm yard manure (FYM), Vermiwash, Neemcake, and Vermicompost and bio inoculants viz., *Azospirillum*, *Phosphobacteria* and *Pseudomonas* are also being used to meet out the nutrient requirement of the crop. Around 73 per cent of the farmers use panchagavya as a major source of nutrient in organic brinjal farming.

Another ITK major product are namely *Amirthakaraisal* (52%) and *Jeevamirtham* is being used by 44 per cent of the farmers in almost all the districts surveyed. Effective

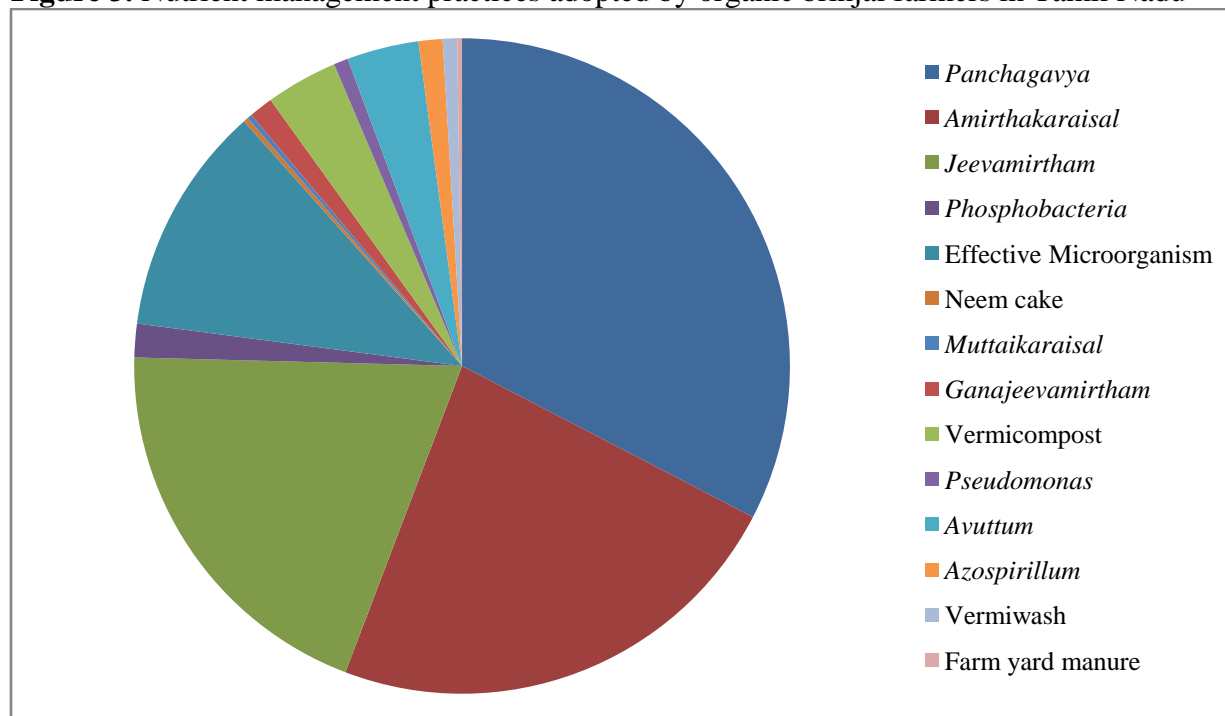
microorganism (EM) constitutes another key nutrient source and is used by 25 percent of the farmers from representing Namakkal, Salem, Thoothukudi and Tirunelveli districts. About 7.97 per cent farmers used vermicompost for crop nutrient management in Salem, Erode and Coimbatore districts. TNAU based panchagavya preparation namely *Avuttam* is being used by 15 farmers out of 23 farmers in the Namakkal districts interviewed. A small portion of the farmers (1.59%) from Thiruvavarur and Erode districts were using Vermiwash. Farmers in Coimbatore districts (1.59%) uses *Pseudomonas* as plant nutrient substitute in addition to its need based use in disease management. Farmers from Thoothukudi and Salem (3%) are also using *Phosphobacteria* as a bio-inoculant for nutrient substitution in their organic brinjal cultivation.



Table 5. Nutrient management practices adopted by organic brinjal farmers in Tamil Nadu state

S. No.	Nutrients Used	No. of farmers	Coimbatore	Madurai	Tirunelveli	Thoothukudi	Salem	Erode	Thiruvarur	Namakkal	Kanya kumari	% of use
1.	<i>Panchagavya</i>	138	16	20	9	13	13	16	24	20	7	73.40
2.	<i>Amirthakaraisal</i>	98	6	10	20	20	4	13	19	-	12	52.13
3.	<i>Jeevamirtham</i>	83	11	20	14	13	2	4	13	-	6	44.15
4.	Phosphobacteria	7	-	-	-	5	2	-	-	-	-	3.72
5.	Effective Microorganism	48	-	-	4	6	15	-	-	23	-	25.53
6.	Neemcake	1	1	-	-	-	-	-	-	-	-	0.53
7.	Muttai karaisal	1	1	-	-	-	-	-	-	-	-	0.53
8.	Ganajeevamirtham	5	2	-	-	3	-	-	-	-	-	2.66
9.	Vermicompost	15	2	-	-	-	9	4	-	-	-	7.98
10.	<i>Pseudomonas</i>	3	3	-	-	-	-	-	-	-	-	1.60
11.	Avuttum	15	-	-	-	-	-	-	-	15	-	7.98
12.	<i>Azospirillum</i>	5	1	-	2	-	2	-	-	-	-	2.66
13.	Vermiwash	3	-	-	-	-	-	1	2	-	-	1.60
14.	Farm yard manure	1	-	-	-	-	-	1	-	-	-	0.53

Figure 3. Nutrient management practices adopted by organic brinjal farmers in Tamil Nadu



Discussion

The organic farmers are in contact with agencies like local extension officers and Subject Matter Specialist of Krishi Vigyan Kendra (KVK) for their knowhow update and training. The ITK practices followed in organic farming reported in the present study is of first documentation and published information on use of ITK is limited. In the report of Vivekandhan (1994) and Kiruba et al. (2006) the ITK practices followed in insect pest management is listed and both the report has list of different plant species as ITK tool in insect pest management. Mainali et al. (2014) indicated the need for developing alternatives for chemical pesticide including indigenous/non-chemical knowledge and practices which are need to be scientifically validated and effectively disseminated. In a similar survey conducted on ITK use in

vegetable cultivation in Nepal. Maharjan et al. (2004) documented some of the traditional methods adopted by few farmers, which include like spreading of wood ashes and spraying cattle urine besides use of light trap and pheromone trap against insect pests of vegetables. Vivekandhan (1994) indicated list of various Indigenous pest control method used by farmers in the year of traditional agriculture. The information gathered on nutrient management practices and the ITK based pest management practices followed by the organic farmers of the Tamil Nadu state in the present study forms a updated information that can be used for planning pest management strategies for organic farming in the state.

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