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Rationality and adoption of primitive crop protection methods followed by tribal farmers in Tamil Nadu

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Abstract
Indigenous Tribal Agricultural Practices (ITAPs) have facilitated intensive farming for a long period of time without significant deterioration of land or decline in crop production. The tribes of the Kolli hills of Namakkal district in Tamil Nadu possessed rich tradition, heritage and experience in agriculture. Their rich wisdom in ITAPs in Plant Protection can effectively be utilized for sustainable agricultural development of tribal areas by appropriately blending the ITAPs with recommended production technological package. Hence, there is an immense need to collect, document, rationalize and refine those ITAPs in Plant Protection before they become totally obsolete. In this context a study was done for collecting, classifying, documenting, analyzing the rationality, and studying the adoption of the selected ITAPs in Plant Protection aspects. About 41 ITAPs on Insect Pest Management, in different clusters of villages of Kolli hills were documented. For assessing the rationality, the selected ITAPs were sent to 50 Plant Protection scientists. Having identified and selected the list of ITAPs with their rationality scores, further analysis was undertaken to test verify their extent of adoption.
Out of 41 ITAPs in Insect Pest Management, 29 ITAPs were rational and 12 ITAPs were found to be irrational as rated by the scientists. Overall extent of adoption of ITAPs was found to be more than 50 per cent as they were practiced for quite long time.
The rational and effective ITAPs should be blended into the technology package for transfer of technology, so that the agricultural development will be sustainable.
This paper discusses about the practice wise rationality and adoption of ITAPs on Insect Pest Management by tribal farmers.

Keywords: Crop Protection, Insect Pest Management, Indigenous Tribal Agricultural Practices, Tribal farmers, Rationality, Adoption

Introduction
Tamil Nadu State in India is a treasure land of indigenous tribal technical knowledge in agriculture and allied activities. The *Malayali* tribal groups in Tamil Nadu, mostly found in Kolli Hills, have rich cultural and agricultural heritage which is situated in the Namakkal district of Tamil Nadu, South India, spread over an area of 441 sq. km at the tail end of the Eastern Ghats in the state of Tamil Nadu. The tribes in Kolli Hills were more traditional in nature having faith in the practices of the local communities. They managed their livelihood through agriculture and maintained a traditional life style through their indigenous knowledge system. The contribution of indigenous communities to the conservation and sustainable use of biological diversity goes far beyond their role as natural resource managers, their skills and techniques provide valuable information to the global community and a useful model for biodiversity policies. As on-site communities with extensive knowledge of local environments, indigenous and local communities are most directly involved with conservation and sustainable use, their rigid social structure with lesser social mobility had kept them away from scientific and technological progress.
The on-going practice of using such knowledge by ethnic communities established the belief that traditional knowledge used was fruitful for the people. Hence, studying the Indigenous Tribal Agricultural Practices (ITAPs) of tribes in Kolli Hills will be helpful for proposing an action paradigm for preservation and diffusion of desirable insect pest management for the benefit of the tribal farming community. Keeping this in view, a study on scientific rationality and adoption of Indigenous Tribal Agricultural Practices on Insect Pest Management was carried out. This paper discusses about the indigenous Insect Pest Management practices adopted by tribal farmers in Kolli hills of Tamil Nadu.

Materials and methods
Kolli Hills is situated in the Namakkal district of Tamil Nadu, South India (78^0 17' 05" E to 78^0 27'45" E and 11^0 55' 05" N to 11^0 21'10" N) are a low ranging hills of Eastern Ghats

spread over an area of 441 sq.km. Kolli Hill has an area of 282. 92 sq. km. It stretches 29 kms from north to south and 19 km from east to west. The Mean annual temperature ranges from 14 ºC to 28 ºC. The area receives an average of 1440 mm of annual rainfall distributed fairly over the two seasons. The elevation ranges between 1000 and 1350 meters MSL. The soils are deep to very deep, non-calcareous and developed from weathered genesis.

Each village of the settlement is called 'oor'. A group of ten to fifteen 'oor' constitutes a 'nadu', clusters of villages. For this study seven clusters of villages were selected from the total 14 clusters of villages (Nadu), in Kolli hills of Namakkal district. Seven cluster villages *viz. Ariyur Nadu, Bail Nadu, Gudini Nadu, Gundur Nadu, Selur Nadu, Thinnanur Nadu and Valappur Nadu* were selected based on the geographical area covered in agriculture under the farming systems. In each of the selected villages, 20 aged and experienced farmers were contacted through informal interview method for collecting indigenous practices associated with Insect Pest Management there. Thus, a total of 140 farmers were contacted.

Indigenous Tribal Agricultural Practices were also collected from secondary sources *viz.* M. S. Swaminathan Research Foundation, State Department of Agriculture and previous studies, apart from the above mentioned farmers. Thus, a total of 41 Indigenous Tribal Agricultural Practices on Insect Pest Management were collected.

The collected Indigenous Tribal Agricultural Practices on Insect Pest Management were then classified systematically based on the four cropping systems and eight technological dimensions.

Rational means explainable with scientific reasons or established facts, based on long time experience; irrational means something/practice that cannot be scientifically explained or supported with long time experience (Sastikannan, 2002). In this study, rationality refers to the degree to which Indigenous Tribal Agricultural Practices can be explained or supported with scientific reasons, or established based on long time experience. Similarly, irrationality refers to the degree to which Indigenous Tribal Agricultural Practices cannot be explained or supported with scientific reasons, or cannot be established based on long time experience. Testing the rationality of the indigenous knowledge items is essential, as it has been envisaged to test the adoption of such knowledge by the farmers.

For assessing the rationality, the selected 41 indigenous plant protection practices were referred to the 50 Plant Protection scientists, by rating them on a four point continuum ranging from 4 to 1.

The rationality of indigenous technologies was assessed by using the scoring procedure adopted by Sakeer Husain (2010) as presented below in Table.1.

Table 1: Scoring procedure to assess the rationality of indigenous technologies

Sl. No.	Responses	Scores
1.	Rational based on scientific evidence	4
2.	Rational based on experience	3
3.	Irrational based on experience	2
4.	Irrational based on scientific evidence	1

To find out the rationality of an Indigenous Tribal Agricultural Practices (ITAPs) in Insect Pest Management, the total score given by all the scientists to individual ITAP was calculated and based on the mean score, the indigenous technologies were classified into two categories *viz.* rational and irrational. If an ITAP scored a mean score of 2.5 and above, it was considered as a "rational" and The ITAPs with a mean score of less than 2.5 were considered as "irrational".

Having identified and selected the list of ITAPs with their rationality scores, further analysis was undertaken to test verify their extent of adoption. Thirty farmers were selected using proportionate random sampling from the above clusters of villages, proportionate to the area. The selected ITAPs were narrated to thirty respondents one by one, each time enquiring whether they had adopted the practice, in the previous years. If the answer was 'Yes', a score of one was assigned and if the answer was 'No', zero score was given. The scores obtained for all the practices were summed up for each respondent and adoption score was arrived at. Then the adoption quotient for each individual was worked out by using the following formula as used by Sundaramari *et al.* (2003).

$$\text{Adoption Quotient} = \frac{\text{Number of Indigenous Tribal Agricultural Practices adopted}}{\text{Number of Indigenous Tribal Agricultural Practices applicable}} \times 100$$

Results and discussion

Practice wise rationality and adoption of ITAPs on Insect Pest Management

Insect Pest Management had 41 selected ITAPs. Thirty tribal farmers of Kolli hills were contacted to assess their extent of adoption. The details on the extent of adoption of individual ITAPs on Insect Pest Management along with their rationality have been presented in the Table.2.

There are 41 ITAPs related to Insect Pest Management, of which 29(70.73%) were rational and 12(29.27%) were irrational.

It could be seen from the Table.2 that 15 ITAPs were (6, 24, 25, 28, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 and 40) adopted by more than 75 per cent of the farmers and except ITAP 6, all the ITAPs were rational.

There were 13 ITAPs (2, 4, 5, 7, 10, 11, 17, 18, 20, 22, 23, 29 and 41) adopted by 50-75 per cent of the respondent and out of which 5 ITAPs (11, 17, 22, 23 and 41) were irrational.

About 10 ITAPs (1, 3, 9, 12, 13, 14, 16, 21, 26, 27) were adopted by only 25-50 per cent of the respondents, of which 5 ITAPs (3, 12, 13, 2, 26) were rational and 5 ITAPs (1, 9, 14, 16, 27) were reported to be irrational.

Insect Pest Management in Paddy

Application of *Calotropisgigantea* in the nursery was followed by 73.33% of the farmer's respondents to prevent thrips attack in the nursery. *Meliaazadirachta* kernel (6 kg) powder mixed with water (200 lit) and allowed to stand whole night undisturbed, filtered and sprayed next morning and was adopted by 46.67% of the respondents to control brown plant hopper and green leaf hopper. About 73.33% of the farmers used neem leaves along with small stems and applied in the field, to prevent the attack of pests and diseases in rice fields. The leaves of *Calotropisgigantea* were pressed and incorporated into the soil in the available inter space in the main field (70.00%) to control brown plant hopper. About 76.67% of the farmers planted Calotropis at 12 feet interval on all sides of paddy fields to control the invasion of hopper. *Notchi* (*Vitexnegundo*) leaf extract is sprayed by 63.33% of the respondents to control rice tungro virus. Seventy % of the farmer's spreaded*Datura* leaves and stems in the paddy field in water stagnate condition and circulated to control the stem-

borer attack. Only 23.33% of the respondents mixed neem oil with water @ 30 ml/l and sprayed to control stem borer in rice field. To control leaf folder and stem borer in paddy 30.00% of the farmers mixed 5 lit of kerosene with soap solution and sprayed in 1 ha. To control sucking pest in rice 66.67% of the farmers dusted ash on the standing crop of paddy and 50.00% of the farmers adopted a practice of mixing fish (3kg),neem leaf (5kg) extract (or) table salt solution spray.

To control leaf folder in paddy 36.37% of respondents adopted spray of *Notchi* (*Vitexnegundo)* leaf extract with buttermilk spray, 43.33% of the respondents adopted spraying of *Adhatodavasica* leaf extract with cow dung and only 13.33% of the farmers adopted the practice of spraying fermented *Agave Americana* leaf along with 2 to 3 drops of lime juice mixed with water. About 66.67% of the respondents sprayed with a filtered solution of *Meliaazadirachta* kernel (6kg per acre) powder mixed with water (200:1) kept overnight undisturbed and 23.33% of the farmers prepared a paste by grinding ten kg of neem leaf with one litre of water, boiled for half an hour and left for overnight and sprayed in the next morning by mixing with 200 litres of water to control leaf folder.

Lemon grass oil along with *Ocimum* leaf extract, butter milk and cow urine were mixed with water and sprayed to control sap feeder by 26.67% of the respondents.

Insect Pest Management in Millets

Dusting of ash over the little millet *(Panicummiliare)*, Italian millet (*Setariaitalica)* or Finger millet (*Eleucinecoracana*) crops at the rate of 15-20 kg/acre was followed by 83.33% of the farmers to control the sucking pest damage which was with the scientific rationale of 2.60 R. Since moisture content of 14 % or less is opting for storing and reduces the risk of damage by storage pest, sun drying is done to dry grains of little millet *(Panicummiliare)*, usually on a new moon day by 73.33% of the farmer respondents.

About 80% of farmer's usedneem (*Azadirachtaindica* L.) leaves and *Thumbai (Leucasaspera* L.*)* leaves for thestorageofFinger millet as the strong odour ofthese leaves keeps awaythe storage pests like lesser grain borers (*Rhyzoperthadominica*), saw toothed beetle (*Oryzaephilussurinamensis*) and flat grain beetle (*Cryptolestesminutus*).

Insect Pest Management in Red gram

Growing Castor on the bunds of the Red gram (*Cajanuscajan*) field was followed by 90% of farmers with the rationality score of 3.39 R, as castor crop attracts the pod borer and prevent the main crop from damage.

*Ocimumcanum*Sims. Have Linalool, which is a strong insecticide with fumigant action. Hence it prevents the seeds from pod borer damage, thus 83.33% of the farmer respondents dry the red gram (*Cajanuscajan*) seeds and store them in gunny bags after placing dried leaves of 'Naithulasi' (*Ocimumcanum* Sims.) inside the bags.

Spreading of Neem leaves over the red gram (*Cajanuscajan*) seeds, were followed by 90% of the tribal farmers, as it have repellent action on the storage pests.

A layer of neem seed oil is smeared on the seeds of *Cajanuscajan, so that* larvae does not enter inside it. Thus the damage is avoided.

About 83.33% of the farmers mixed 200 gmofsaltper kgofred gram (*Cajanuscajan*) grains manually. These treated grains are then stored in jutegunny bag sand the bags are stitched. Due to this practice, insects are kept away from the stored grains, assalthasabrasive action on insect skin prevents its movement inside the storage containers. It helps in storing the seeds for a short-term duration of 6-8 months.

Storage pest, pulse beetle is being controlled by dusting turmeric powder or dusting the powdered *Vitexnegundo* L. Leaves. This practice was adopted by 83.33% of the respondents.

Usage of dried chillies pod in the red gram containers was adopted by 83.33% of the respondents, since they knew that bruchids (beetle) attack may be avoided by this practice.

Mixing 2½ kg. Of red earth slurry with 50kg. Of red gram seeds and drying them before storage was with scientific rationale of 3.34 R, since the seeds coated with red earth acts as pest repellent.

Insect Pest Management in Vegetables and root crops

To control the shedding of flowers and pre mature fall of pods in field bean *(Lablab purpureus)*, 80% of the farmers used a mixture of extracts of nochi (*Vitexnegundo* L.) leaves and neem cake and sprayed.

The farmers used Latex of (Mango + Calotropis + Jatropha) + hot water to control of aphids and white fly in tapioca *(Manihotesculenta)*, but was found irrational with the scoring of 2.29R.

The above finding is online with the research support from that of Dhaliwal *et al*. (2010), Majumder *et al*. (2013), Mehta *et al.* (2012), Mohammed *et al*. (2008), Purusottam*et al.* (2009) and Subba (2009)

Table 2: Rationality and adoption of ITAPs on insect pest management (n=30)

S. No.	ITAPs on insect pest management	Rationality score	Adoption %	Scientific rationale
	Paddy			
1.	Soaking the paddy seeds in diluted cow's urine before sowing.	1.95 IR	33.33	Reduces the incidence of leaf spot and rice blast.
2.	Neem leaves along with small stems are applied as green leaf manure in the field.	3.02 R	73.33	Neem has manurial and pesticidal value.
3.	The top portion of seedling is clipped before transplanting.	3.65 R	43.33	To prevent the seedling getting uprooted by strong winds and also helps to remove stem borer and hispa eggs, if present.
4.	Application of *Calotropisgigantea* (L.) Dryand. In the nursery.	2.80 R	73.33	Prevent thrips attack in the nursery.
5.	The leaves of *Calotropisgigantea* (L.) Dryand. Are pressed and incorporated into the soil in the available inter space.	2.60 R	70.00	Controls brown plant hopper in the main field.
6.	Growing or planting *Calotropisgigantea* (L.) Dryand. At 12 feet interval on all sides of paddy fields.	2.34 IR	76.67	Controls the invasion of hoppers in paddy field.

7.	*Daturametel*L. Leaves and stems are spread in the field, then blocked through bunds and then the decomposed leaves and stems are circulated throughout the field.	2.80 R	70.00	The smell as well as the bitterness of Datura leaves is the reason to distract the stem-borer pest from approaching the area.
8.	Neem oil is mixed with water @ 30ml. /lit. And sprayed.	3.73 R	23.33	Controls stem borer in rice
9.	Spraying 5 lit of kerosene mixed with soap solution in 1 ha of paddy field.	1.88 IR	30.00	Kerosenated soap water suffocates and kills the larvae of leaf folder and stem borer.
10.	To control earhead bug in paddy, powder of neem seed kennel is applied to the crop 2-3 times after transplanting.	3.21 R	66.67	Neem seed kernel powder controls the pests like brown plant hopper and leaf hopper.
11.	Dusting of ash on the standing crop of paddy.	2.37 IR	66.67	Sucking pest such as brown plant hopper in rice is controlled.
12.	*Notchi* (*Vitexnegundo L.*) leaf extract and Buttermilk spray	2.78 R	36.67	It is being used to control leaf folder.
13.	*Adhatodavasica*Nees.leaf extract and cow dung spray.	2.60 R	43.33	Used for the control of leaf folder.
14.	A mixture of 5 kg of common salt and 15 kg. Of sand is applied for 1 acre.	1.63 IR	40.00	This practice helps to control brown spot disease.
15.	*Agave americana* L. leaf with 2-3 drops of lime juice (fermented for 4-5 days) is mixed with water and sprayed.	2.10 IR	13.33	This is done for the control of leaf folder in rice.
16.	Lemon grass oil and *Ocimumsanctum* L. leaf extract with butter milk and cow urine are mixed with water and sprayed.	2.46 IR	26.67	This method controls sap feeders.
17.	Fish (3kg) with Neem leaf (5kg) extract (or) Table salt solution spray 4% /ac are used to control all pests in rice.	2.41 IR	50.00	Common salt creates abrasion on the skin of insect pests and neem leaf extract helps to control the sucking pests.
18.	*Meliaazadirachta* L. kernel (6kg per acre) powder is mixed with water (200:1). This solution is kept overnight undisturbed. It is filtered and sprayed on the next morning.	3.43 R	66.67	*Meliaazadirachta* L. kernel solution spray controls the pests like brown plant hopper and leaf hopper of the rice crop.
19.	A paste neem leaf is boiled for half an hour and left for overnight and sprayed in the next morning by mixing with 200 liters of water.	2.73 R	23.33	This controls leaf folder in rice crop.
20.	Turmeric powder is mixed with paddy and then stored.	3.43 R	66.67	Turmeric powder controls weevils and stored grains.
21.	*Vitexnegundo*L. Leaf extract spray (or) Vitex leaves + neem leaf extract spray.	3.51 R	33.33	Rice weevil is controlled by practice.
22.	Paddy seeds are stored in a floor coated with cow dung slurry to avoid insect attack.	2.37 IR	50.00	This practice avoids insect attack in paddy grains.
23.	Vessel filled with water is kept inside the store room to attract the insects and to reduce damage.	2.07 IR	63.33	This practice would attract and kill the rice moth (*Corcyra cephalonica*).
24.	The leaves of notchi (*Vitexnegundo*L.), neem (*Azadirachtaindica*L.) And pungam (*Pongampinnata*L.) are used along with the seeds of paddy to ward off storage pests.	3.60 R	83.33	Notchi, neem and pungam do haverepellent action on storage pests.
25.	Leaves of *Cipadessabaccifera* (Roth).Miq.) Are spread over the paddy seeds in the storage structure.	3.00 R	100.00	Repellent action over the storage pests.
26.	20-30 red chillies in one quintal of rice bag prevents the attack of stored grain pests.	2.95 R	46.67	The pungent odour of red chillies acts as a repellent.
27.	Pepper powder is used for the control of Storage pest in paddy.	2.34 IR	43.33	Pepper smell drives away any storage pest.
		Millets		
28.	Dusting of ash over the Little millet *(Panicummiliare)*, Italian millet (*Setariaitalica)* or Finger millet (*Eleucinecoracana*) crops at the rate of 15-20 kg/acre.	2.60 R	83.33	Sucking pests are effectively controlled.
29.	Sun drying is done to dry grains of Little millet *(Panicummiliare)*, usually on a new moon day.	2.61 R	73.33	Moisture content of 14 % or less is opting for storing and reduces the risk of damage by storage pest.
30.	Farmer's useneem (*Azadirachtaindica*L.) leaves and*Thumbai (Leucasaspera*L.*)* Leaves for thestorageof Finger millet.	3.07 R	80.00	Thestrongodouroftheseleaves keeps awaythe storage pests like lesser grain borers (*Rhyzoperthadominica*), saw toothed beetle (*Oryzaephilussurinamensis*) and flat grain beetle (*Cryptolestesminutus*).
		Red gram		
31.	Castor is grown on the bunds of the Red gram (*Cajanuscajan*) field.	3.24 R	90.00	As castor attracts the pod borer and prevent the main crop from damage.
32.	Drying the red gram (*Cajanuscajan*) seeds and storing them in gunny bags after placing dried leaves of	2.95 R	83.33	*Ocimumcanum*Sims. Have Linalool, which is a strong insecticide with fumigant action. Hence it

	'Naithulasi' (*Ocimumcanum*Sims.) inside the bags prevents pod borer attack.			prevents the seeds from pod borer damage.
33.	Neem leaves are spread over the red gram (*Cajanuscajan*) seeds,which repels the insects.	3.39 R	90.00	Neem does haverepellent action on storage pests.
34.	A layer of neem seed oil is smeared on the seeds of *Cajanuscajan*.	3.39 R	90.00	Larva does not enter inside it. Thus the damage is avoided.
35.	About200gmofsaltismixedfora kgofredgram (*Cajanuscajan*) grainsmanually. Thesetreatedgrains arethenstoredin jutegunny bagsandthebagsarestitched. Duetothispractice, insectsarekeptaway fromthestoredgrains.	2.85 R	83.33	Assalthasabrasiveactionon insect skin prevents its movement inside the storage containers. It helps in storing the seeds for a short-term durationof 6-8 months.
36.	Dusting turmeric powder or dusting the powdered *Vitexnegundo*L. Leaves.	3.05 R	83.33	Storage pest, pulse beetle is being controlled by this method.
37.	Putting the pods of dried chillies in the red gram containers	2.95 R	83.33	Controls bruchids (beetle) attack.
38.	Mixing the dried leaves of nochi (*Vitexnegundo* L.) or neem with red gram seeds before storage.	3.56 R	90.00	Notchi and neem do haverepellent action on storage pests.
39.	Mixing 2½ kg. Of red earth slurry with 50kg. Of red gram seeds and drying them before storage.	3.34 R	76.67	Seeds coated with red earth acts as pest repellent.
Vegetable and root crop				
40.	A mixture of extracts of nochi (*Vitexnegundo* L.) leaves and neem cake is sprayed.	2.98 R	80.00	To control the shedding of flowers and pre mature fall of pods in field bean *(Lablab purpureus)*.
41.	Latex of (Mango + Calotropis + Jatropha) + hot water.	2.29 IR	73.33	This practice is used for the control of aphids and white fly in tapioca *(Manihotesculenta)*.

Conclusion

It could be concluded that adoption of ITAPs on Insect Pest Management was found to be higher as a majority of 28 out of 41 ITAPs were adopted by more than 50 per cent of the farmers. The tribes of the Kolli hills possessed rich tradition, heritage and experience in Insect Pest Management of agricultural and horticultural crops. Their rich wisdom in ITAPs in Insect Pest Management can be effectively utilized for sustainable agricultural development of tribal areas. It could also be concluded that the farmers have experiential wisdom which they use to conserve and select location specific indigenous varieties of Hill banana for obtaining sustainable yield. Such stabilizing qualities of traditional practices must be supported and complemented by agro-ecological practices that enhance the soil, water and germ plasm conservation potential of traditional technologies.

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References

1. Dhaliwal RK, Gurdeep Singh. Traditional food grain storage practices of Punjab, Indian Journal of Traditional Knowledge. 2010; 9(3):526-530.
2. Majumder D, Deka SN, Pujari D, Das PK. Traditional Knowledge adopted by the farmers for management of rice pests in North bank plain zone of Assam, Indian Journal of Traditional Knowledge. 2013; 12(4):725-729.
3. Mehta PS, Negi KS, Rathi RS, Ojha SN. Indigenous method of seed conservation and protection in Uttarakhand Himalaya. Indian Journal of Traditional Knowledge. 2012; 11(2):279-282.
4. Mohammad Amiri, Mohammad Hosein Emadi. Traditional knowledge of Iranian farmers on biological pest management. Indian Journal of Traditional Knowledge. 2008; 7(4):676-678.
5. Purusottam Mohapatra, Ponnurasan Nand, Narayanasamy P. Tribal pest control practices of Tamil Nadu for sustainable agriculture. Indian Journal of Traditional Knowledge. 2009; 8(2):218-224.
6. Sakeer Husain A. Knowledge, adoption and perceived effectiveness of Indigenous Horticultural Practices in Kerala, Ph. D. thesis, GRI (DU), Gandhigram, Dindigul, Tamil Nadu, 2010.
7. Sastikannan A. A study on knowledge and adoption of indigenous plant protection practices in Madurai district, M. Sc. (Ag.) Thesis, Annamalai University, Annamalainagar, Chidambaram, Tamil Nadu, 2002.
8. Subba JR, Indigenous knowledge on bio-resource management for livelihood of the people of Sikkim. Indian Journal of Traditional Knowledge. 2009; 8(1):56-64.
9. Sundaramari M, Ranganathan TT. In: Indigenous Agricultural Practices for Sustainable Farming, (Agrobios (India) Publishers, Jodhpur, 2003.