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Short Research Article

Traditional Pest and Disease Management Practices in Sikkim Himalayan Region

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Abstract

Local knowledge or Indigenous Technical/Traditional knowledge (ITK) is the knowledge belonging to a specific community or local group and that the people in a given community have developed over time, and still continue to develop. Agriculture and allied activities continue to be an important occupation and form the main base of the economy in Sikkim. There are various pests and diseases in crop plants which cause severe loss in yield resulting in reduced production. Farm folk of Sikkim follow number of traditional pest management practices for managing pests and diseases of various crops. A study was conducted during June 2013 to 2015 on traditional pest and disease control measures adopted by the farmers in Sikkim. Different itks like use of wood ash, kerosene, table salt, lime, cow urine, cow dung, some unique indigenous plants and indigenous techniques like insertion of bamboo pegs were used by the farmers for the management of various insect pests and diseases occurring in Sikkim. Besides, people also use some indigenous pest and disease resistant varieties of large cardamom, maize, buckwheat and tomato. This report is an attempt to document some of the indigenous practices followed by traditional farmers for the management of pests and diseases of major crops grown in Sikkim. The practices collected in this study will be of great help to the people of Sikkim as the state has been declared recently as organic farming state.

1. Introduction

Sikkim is a small multi-ethnic state, located in the Eastern Himalayas covering a geographical area of 7096 sq km, representing a meagre (0.22%) portion of India's geographical area. The State is divided into four districts, North, West, East and South. Sikkim, constituent state of North-eastern Region of India has a diversified ecosystem. Great diversity is found in most of the food crops and large part of the arable land is planted with local cultivars. The major ethnic groups of the region are *Lepcha*, *Bhutia* and the Nepalese. Each of these ethnic groups and sub-groups has its own distinct culture, language and traditions (Hussain and Hore, 2009). Agriculture and allied activities continue to be an important occupation and form the main base of the economy. Agriculture is maize-based but large cardamom; ginger and mandarin are the main cash crops. There are various pests and diseases in crop plants causing severe loss in yield resulting in reduced production due to prevalence of favourable climatic conditions like continuous heavy rainfall (159−671 mm), low temperature (7.5−28.2 °C) and high humidity (87.3−93.3%) in Sikkim Himalayan region. Farmers in Sikkim follow number of traditional practices for managing pests and diseases in various crops. Traditional or Indigenous Technical Knowledge (ITK) is the actual knowledge of a given population that reflects the experiences based on tradition and includes more recent experiences with modern technologies. Indigenous practices are an unwritten body of knowledge. It is held in different brains, languages and skills in as many groups, cultures and environments as are available today (Atte, 1989). Indigenous knowledge is an integral part of the culture and history of a local community and that we need to learn from local communities to enrich the development process (PongeI, 2011). Management of crops in general and pest management approaches in particular are different among traditional farmers practicing traditional farming systems in different regions of the country because of difference in indigenous knowledge they accrued over generations of their close contact with the nature (Chhetry and Belbahri, 2009). Prior to the advent of Green Revolution, Indian farming was largely based on indigenous technical knowledge of the farmers. The methods of controlling pests and diseases and building soil fertility and structure were indigenous in nature since farming did not include the use

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of chemical pesticides or fertilizers (Talukdar et al., 2012). Indigenous pest and disease management practices generally involve use of locally available resources for the successful cultivation of crop plants, therefore it is eco-friendly and also sustainable. Sikkim is the first organic state in India and was declared very recently as fully organic farming state. Indigenous pest and disease management practices will play a very important role in organic farming in Sikkim. However, the study on the documentation of traditional practices most importantly ITKs on pest and disease management has not yet been done systematically. Keeping this in consideration, the present study was undertaken to collect the information on ITKs used by the farmers of Sikkim Himalayan region for the management of pests and diseases.

2. Materials and Methods

During survey for insect pests and pathogens associated with various crops cultivated in Sikkim, information on indigenous methods used for pest and disease management adopted by the farmers were collected. Simple questionnaire and participatory rural appraisal (PRA) tools were used to collect the information. The study was carried out in different villages of Sikkim. The survey included group and individual interviews of farmers in villages and officials in State Agriculture Department. About 300 farmers from different communities with varying age group were interviewed during 2013−15 to record information about ITKs. Farmers were asked questions like pests and diseases incidence on crop plants, importance of various cultivation practices in the management of pest and diseases, use of plant extracts, chemicals and other mechanical measures used by the farmers. Some of the explored indigenous traditional knowledge (ITKs) for the management of pests and diseases in major crops of Sikkim are discussed below in detail.

3. Results and Discussion

3.1. Use of wood ash, lime and table salt

Wood ash is used for the storage of cereals and pulses. Ash is mixed thoroughly @ 20 g kg^{-1} seeds for the storage of maize, rice bean, green gram, pahenlo dal and okra seeds meant for seed purposes. Ash kills insects by desiccation or by filling the intergranular spaces restricting insect movement and insect emergence (Chandola et al., 2011). Ants, cut worm and white grub are the major pests of vegetables and for controlling these pests wood ash is very commonly used by the farmers in Sikkim. Farmers use variety of control measures like application of wood ash and salt for the management of ants. Ash and salt is applied at 10 to 15 cm away from the root zone of the plant. Painting of lime on the trunk of mandarin plants infected with gummosis (*Phytophthora* spp.), bark eating caterpillar, trunk borer is also a very common technique among the farmers. Table salt, lime and wood ash is used for the management of Giant African Snails which are the major pests of crop plants growing near the Teesta River. Table salt, lime and wood ash also used for the management of leech.

3.2. Use of kerosene

Kerosene is applied for the management of trunk borer and stem borer in mandarin. The hole made by the trunk borer and stem borer is plugged using mud or cow dung after applying kerosene. Some farmers in Dzongu area of North Sikkim also use kerosene for storage of pulses meant for sowing.

3.3. Cow urine and cow dung extract

Cow urine and cow dung extract is used for nutrient supply and also for pest and disease management in ginger, Sikkim mandarin and other vegetable crops. Cow dung is mixed with mud and painted on the trunk of the tree to avoid trunk borer and bark eating caterpillar. Narayanasamy (2002) also reported the effect of cow urine in the management of fruit borer and leaf beetle (*Epilachna viginctiopunctata*) due to its repelling activity. He also reported that cow dung extract @ 2% concentration was effective against earhead bug, BPH, leaf folder, stem borer, caterpillars and other chewers in rice. Farmers use specially made bamboo structure plastered with cow dung and clay (*bhakari*) for the storage of grains and large cardamom. This kind of cow dung plastering is also very common in other parts of India (Rizwana and Lyaquet, 2011). Strong plastering of bamboo crevices inhibits the entry of pests and other storage pathogens.

3.4. Insertion of bamboo peg

In some places, farmers insert bamboo peg for the management of trunk borer (*Anoplophora versteegi*). It was said that the sharp end of the peg kills the trunk borer larvae and it also depletes oxygen which kills the larvae by suffocation.

3.5. Mulching

Mulching is one of the important methods in cultivation of ginger. Immediately after planting, beds are covered with mulches consisting of forest litter, titeypati (*Artemisia vulgaris*), chilouney (*Schima wallichii*) and banmara (*Chromolaena odorata*) up to 8−10 cm thickness. Mulching suppresses the weeds besides protecting the crop from pests and diseases and improving the germination in ginger (Rahman et al., 2009).It also protects the soil from erosion on hilly slopes. Kumar et al. (2012) found that mulching with chilouney (*Schima wallichii*) was very effective in controlling soft rot and bacterial wilt of ginger in Sikkim.

3.6. Other cultural control measures

The farmers in West Sikkim remove and reapply fresh irrigation water during pest and disease outbreak. Alternate

drying and wetting of rice field for few days is also one of the indigenous practices followed by the farmers especially against case worm and leaf folder in rice. The fruit flies infected mandarin fruits are collected in big drums upon falling on the ground. The chemicals formed during fermentation of fruit juice leads to death of fruit fly larvae. Stone trap locally called *Darab* is used for controlling rats in agricultural fields.

3.7. Use of plant products

Farmers use Plant materials for protection of plants from pests and diseases and also for improving the nutritional status of the soil. Among the plants, titeypati, chilouney, banmara, neem, lantana, datura play a very important role in pest and disease management. The plants and their use in pest and disease management are given below (Table 1).

3.8. Indigenous local cultivars

Farmers in Sikkim generally prefer traditional land races which have good adaptability and pest and disease resistance. Many of the landraces in Sikkim has several desired traits of potential use in crop improvement. Krishna bhog, Bhrimphul, Gujri bhog, Thaparey, Kalo nunia and Nunia are aromatic rice varieties and also show blast tolerance (Rahman and Karuppaiyan, 2011). The local cultivars of large cardamom are Ramsey, Sawney, Golsey, Varlangey, Seremna, Ramla and Madhusey. Dzongu Golsey is relatively tolerant to Chirkey disease (Rahman and Karuppaiyan, 2011). Seremna is high yielding and somewhat tolerant to disease like leaf blight (*Colletotrichum gloeosporioides*). Maize is one of the important cereal crops of Sikkim. Germplasm exploration and collection programme in Sikkim has revealed the existence of large number of indigenous maize cultivars befitting to different altitudes. The local varieties cultivated in Sikkim have high tolerance to various diseases and pests. Some of them like Sethi makkai and Pahenlo makkai have thick husk coverage and oblong cob orientation which imparts resistance against ear rot in rainy season. Local germplasms such as Murli makkai, Tempo Rinzing and Sethi makkai are being utilized in the on-going breeding programme at the ICAR Sikkim Centre, Tadong. Buckwheat variety tithey is found to be tolerant to downey milew caused by *Perenospora documeti*. The local varieties of tomato also show tolerance to late blight and it can be used for imparting late blight resistance in improved high yielding tomato varieties.

3.9. Indigenous knowledge and North Eastern states

North Eastern region of India is rich in indigenous knowledge

Table 1: Important botanicals and botanical preparations in pest and disease management

Sl. no.	Name of plant	Pest or diseases controlled in crops	Remarks
1.	Titeypati (*Artemisia vulgaris*)	(a) Ragi (*Eleusine coracana*): used to cover the nursery bed from birds and disease attack. (b) Ginger (*Zingiber officinale*): It is used as mulching material to manage soft rot, bacterial wilt, Fusarium dry rot. (c) Large cardamom (*Amomum subulatum*): It is used for shade management in large cardamom.	Water extract of the plant is good larvicide like kerosene. It has also insecticidal, antibacterial and antifungal property (Ghosh et al., 2013). Farmers believe that mulching would increase germination; reduce weed growth and soft rot in ginger (Rajan, 1999).
2.	Banmara (*Chromolaena odorata*)	(a) Ginger (*Zingiber officinale*): It is used as mulching material to manage soft rot, bacterial wilt, Fusarium dry rot.	It is normally used for cut wounds to stop bleeding.
3.	Chilouney (*Schima wallichii*)	Ginger (*Zingiber officinale*): It is used as mulching material to manage soft rot, bacterial wilt, Fusarium dry rot.	It was found to be effective in the management of soft rot in ginger (Kumar et al., 2012).
4.	Dried peels of mandarin (*Citrus reticulata*)	Rice: Storage Pests	The dried mandarin peel controls insect pests in rice (Talukdar et al., 2012). Peeled rinds of citrus (*Citrus* spp.) or lemon (*Citrus lemon*) are placed sporadically in the field after transplanting for the management of stem borer in rice.
5.	Hatibar (*Agave sissalana*)	Vegetables: ants	The fermented mixture of *Agave sissalana*, *Piper nigrum*, *Vernonia amygdalina* and *Nicotiana tobaccum* is used in Kenya for the management of termites in the field (Ghosh, 2000).

Sl. no.	Name of plant	Pest or diseases controlled in crops	Remarks
6.	Bokey Timbur (*Zanthoxylum allatum*)	Used against leech and other insect pests	It contains the alkaloid magnoflorine.
7.	Datura (*Daturastramonium*)	Ants	The plant extract is mixed with cow urine before drenching the soil.
8.	Neem (*Azadirachta indica*)	Storage pest of paddy	It contains various alkaloids. Talukdar, et al. (2012) from Assam reported that The disagreeable odour as well as insecticidal properties of the leaves keeps away most of the stored grain pests including weevil and grain moth.
9.	Angeri (*Lyonia ovalifolia*)	The leaf extract of angeri is used against cut worm, aphid etc.	Angeri plant contains insecticidal andromedotoxin (Khare, 2009).
10.	Tobacco (*Nicotiana tobaccum*)	Management of leech	It acts as a repellent (Bam et al., 2015).
11.	Bakainu (*Melia azadirach*)	Dried leaves are spread inside the granaries for controlling storage pests in rice.	The anti-feedant effects of *M. azedarach* extracts are known for many insects (Carpinella et al., 2007; Nathan, 2006, Faraga et al., 2011).
12.	Turmeric (*Curcuma longa*)	Management of ant	The required quantity of turmeric powder is mixed with water and drenched at the base of the ant infested plant.
13.	Moringe (*Dendrocnide sinuta*)	Management of rat	Ghee is painted on both side of the leaves and kept inside the grains storage room or some edible items are kept on the moringe leaves. The tongue of rat gets swelled when it touches the leaves.
14.	Fermented plant extract of titeypati (*Artemisia vulgaris*), angeri (*Lyonia ovalifolia*), banmara (*Chromolaena odorata*), piro unew (*Christella acuminata*) (fern)	Sikkim mandarin (*Citrus reticulata*): The mixture of fermented plant extract is used for the management of bark eating caterpillar (*Indarbela quadrinotata*), trunk borer (*Anoplophora versteegi*), aphids (*Toxoptera citricidus*) and ants.	The plants are crushed with water and kept for fermentation for 21 days. After 21 days the fermented plant extract preparation is used for drenching the soil in Sikkim mandarin against Trunk borer, bark eating caterpillar and ants. The unpleasant odour of this fermented plant extract has repellent and anti-feedant effect against various insect pests. Note: Piro unew is also used for ripening of banana and hatching of hen eggs.
15.	Fermented plant extracts mixture made up of titeypati (*Artemisia vulgaris*), banmara (*Chromolaena odorata*) and *Lantana camara*	Tomato and chilli: aphids and white flies	It has anti-feedant and repellent effect against insect pests.

maintained and nourished by hundreds of ethnic tribes and communities. Use of plants and animal parts and products are the important components of indigenous knowledge in the management of pest and diseases of crops in all the North Eastern regions. Firake et al. (2013) reported more than 85 ITKs on pest management from Meghalaya. Rahman et al. (2009) reported ITKs of plant protection in ginger of North East India. Chanu et al. (2010) reported 12 ITKs from Manipur on pest and disease management in upland rice. Taluktar et al. (2012) reported 57 ITKs utilized in *Boro* rice cultivation by farmers of Kamrup District of Assam with highest number of ITKs were identified under plant protection. The indigenous knowledge on pest and disease management collected from Sikkim also has some similarities with other North Eastern

states. Use of ashes of fire wood, lime, neem seed powder, peels of citrus, lemon and pomelo and other botanical preparations for the management of both storage and field pests are very common among the people of Assam and other North Eastern states.

Kerosene oil and salt in the management of pest and diseases have also been reported from other North Eastern regions like Assam (Debanand and Mayuri, 2010; Talukdar et al. 2012). Storage of cereals in Bhakeri and other locally made bamboo structures is also very much common among people of North Eastern India.

4. Conclusion

Traditional practices have been developed through practical experience of the local population of the particular region. The methods have been designed with great ingenuity. Since, ITKs are eco-friendly and organic in nature, so proper documentation, scientific validation and refinement with modern technical knowledge is essential to conserve this knowledge and use effectively for sustainable crop cultivation. ITKs are cheap, easy to adopt, locally available and reduce the input of chemical pesticides in our food chain and the environment.

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