Indian Journal of Traditional Knowledge
Vol. 10(2), April 2011, pp. 311-315

Indigenous pest management practices prevalent among hill farmers of Uttarakhand

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Received 27.08.2008; revised 22.12.2009

Indigenous pest management practices were used before the arrival of chemical pest management. These were location and pest specific and cheap. With those practices, farmers would manage pests effectively without deteriorating environment. These practices could be very important if incorporated into integrated pest management research to enrich the research process and make it more relevant for the farmers. For this to happen, their documentation and scientific testing is necessary. In Uttarakhand hills, farmers are still managing pests with indigenous methods. Due to the prevalence of traditional system of farming, there are many chances of finding indigenous pest management practices. The study identifies various indigenous pest management practices and scientific basis of practicing them.

Keywords: Traditional agriculture, Indigenous pest management, Crop production, Uttarakhand

IPC Int. Cl.[8]: C05G3/00, A01M1/00, A01M5/00, A01M31/00, A01N3/00

Agriculture of the Himalayan state has always been nature and eco-friendly due to their rich traditional and distinctive practices. These areas have always been prosperous in biomass. Despite limited irrigation facilities, fragmented and small land holdings and non–availability of modern inputs, agriculture in the Himalayas has supported its people for generations in adverse conditions and continued to remain, even today the principal source of livelihood[1]. About 80% of the working population in remote hill villages is engaged in agriculture and animal husbandry. Due to harsh topography and climate and the subsequent in accessibility of the area, traditional mountain farming systems in Uttarakhand were self sufficient, self contained, closed systems, which did not require any outside input. Instead, traditional management and ecological knowledge have been the vital means by which farming communities have evolved diversity rich food production and livelihood systems. Owing to limitations – in the form of lack of irrigation, small and scattered landholdings, and low soil – depth, high altitude, heavy rainfall and cold climatic conditions – agriculture in the mountains exhibits a lot of variations in crop diversity, crop composition and crop rotation. Moreover it is also inextricably linked to animal husbandry and forests. Forest biomass fertilizes the fields in the form of organic manure via livestock and through humus coming directly from rainwater run-off from the forests. For controlling menacing diseases and insect-pests in agriculture, farmers for centuries, have relied on indigenous methods. It has been found that all of those are not effective. Considering that government is stressing on popularization of Indigenous Pest Management (IPM) package of practices but its adoption by hill farmers is either very little or nil. If efforts are made to identify and integrate effective indigenous practices with IPM package of practices, chances of their adoption are more. The paper aims to describe indigenous pest management practices being followed by farmers of Bageshwar district of Uttarakhand and their belief behind following them.

Methodology

The study was conducted in district Bageshwar of Uttarakhand. It is a well known fact that the chances of finding indigenous practices are more in agriculturally less progressive areas. That is why out of the two blocks of district Bageshwar namely Bageshwar and Kapkot, Bageshwar block was selected for the study. Within Bageshwar block, two villages were selected; one belonging to irrigated

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region (Gwarbhilkot) and other from rain-fed (Kalag-gajali). The total numbers of respondents contacted were 120. The data has been collected with the help of semi-structured interview schedule, key informants, observation and focused group discussion. Documented practices were then placed before the entomologists and plant pathologists of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar in the form of questionnaire to explore the scientific rationality behind those practices.

Results and discussion

White grub

White grub constitutes a major pest of field crops in Western Himalayas. Earlier, their damage was reported from few pockets only but over the years, it has assumed the status of a serious pest in the entire hilly region causing damage to upland rice, a major hill crop to the extent of about 80% under rain-fed conditions[2]. Out of 31 identified species of white grub beetles in Western Himalayas so far, *Anomala dimidiate* (Hope) (Rutelinae: Coleoptera) has been the most prominent species in Kumaun hills of Uttarakhand[3,4]. White grub depredations are particularly heavy in the terraced slopes of the hills situated between 1400 – 2200 m elevations, which are mostly rain-fed[5]. For controlling it, the hill farmers of Uttarakhand are following these practices:

Setting fire in the field

After harvesting of wheat crop, hill farmers burn the plot. For burning, they collect pine leaves from the forest and distribute those evenly in the field to dry. If they are already dried, they are put to fire to destroy the hibernating stage of white grubs. Scientists did not consider it a good practice because micro-organisms are also burnt and killed.

Spreading of decomposed Farm Yard Manure

It was found that some farmers due to lack of labour prefer to make number of heaps of un-decomposed Farm Yard Manure (FYM) in the fields. They used to carry the FYM from their animal sheds to the fields throughout the year, especially during lean period. It was observed by the farmers that white grub attacks are more severe around these heaps. That is why they say properly decomposed FYM must be used to check white grub attack. According to the scientists, this practice is very much rational as white grubs lay eggs in un-decomposed FYM on which early stages of white grubs feed.

Transplanting of paddy crop

Farmers of Gwarbhilkot village preferred transplanting of paddy wherever there is availability of water due to presence of natural water source in the plot. For transplanting, they raise nursery in their field near their house. They sow seed by broadcasting and one and half month old seedlings are used for transplanting. For preparing fields, male farmer puddle it with indigenous plough tied on the back of bull at least one day prior to transplanting. There is a belief among the farmers that puddling destroys the homes of insects by disturbance thereby killing them. But due to lack of male labour available for transplanting, farmers were abandoning the practice.

Use of table salt

For controlling white grub, common salt is broadcasted at the rate of 1 kg/*Nali. Nali* is an area measurement used in hills. One *Nali* is equal to one by 20 acre. Farmers in hills use salt stone for household as well as for this purpose. They finely grind salt stone and mix it with *chullah* ash to make it bulky. This mixture is broadcasted in the field after first ploughing which is done after wheat harvest. Broadcasting is generally done in the morning hours. Just after broadcasting, wherever possible, land is preferred to be irrigated. The practice is carried out in the field where white grub damage is severe. A similar practice is being carried out by the farmers of Tripura for controlling stem borer of paddy crop. They apply about 30 kg of common salt in one hectare field[6]. Practices related to use of common salt for wilt disease avoidance and control are also been reported. For controlling wilt (locally known as *Sukara*) disease in paddy and pigeon pea, farmers of South Gujarat incorporate common salt in the soil[7].

Burning of cow-dung cakes

White grub also causes considerable loss to vegetable crop also like chilli. Farmers grow chilli in kitchen gardens. They transplant seedlings of chilli plant by digging holes of 5 -7.5 cm. For sterilizing, they burn cow dung cakes, pine leaves and leaves of other plants in it. Ash made by this provides nutrients to seedling. It was reported by the farmers that after this, attack of white grubs on chilli plant is not observed.

Rodent pests

There is a popular saying in *Kumaoni* (local dialect) *Kurmu baad chucha chu jo bahut hai tung kerun (*After white grub, rats cause the major

problem). Rodents are the pests of agricultural produce at every stage; that is seedling, growth, harvesting and storage[8]. Ecologically, India is one of the most diversified countries harbouring at least 52 genera and 118 species of rodents[9]. Rodents inflict severe damage to almost all standing agricultural crops, stored food grains, afforestation trees, grass and fodder crops and other useful commodities and they are the most destructive among all vertebrate pests. They are also involved in transmitting more than 20 dreaded diseases[10]. Efforts are being made to control these noxious rodent pests for centuries through chemicals and various other methods[11]. Methods used by hill farmers of Uttarakhand for controlling them are described below:

Baiting

Bait is made by kneading 1 kg wheat flour and ½ kg ground glass with little water. Table tennis boll size balls are made from the mixture. Balls are kept near the hole in the field in the night. Killing rodents by baiting has been the most preferred and popular method among the farmers. This kind of practice has also been recorded[12-14].

Urea

Balls of urea are also kept for distracting rodents from the field. Balls are made by mixing urea with water. These balls are kept at the entrance of mouse hole. Though scientists were not fully confident about the scientific rationality but they said that urea releases ammonia gas which might distract and some time kill rodents.

Plants causing physical injury

Sisun or Bichhu (Urtica dioica) grass and thorny bushes of *Kilmora (Berberis asiatica* Roxb.) plant are placed at the mouth of mouse hole. *Kilmora* is having thorny bushes whereas *sisun* or *bicchu* grass causes irritation on touching it. For checking the mouse attack in kitchen garden, farmers place leaves of *Bicchu* grass and thorny bushes of *Kilmora* to the mouth of mouse hole so that when it will move through, it will get physical injury. Scientists were not convinced that this practice has got anything to do with reducing rat population or severity of attacks to plants. But considering villagers point of view, they said as it causes physical injury to humans so villagers might think it also causes physical injury to rodents, thereby scaring them to leave the crop field. Similar kind of practice was also found in Kankapura, where farmers plant *Gubasi mullu* (*Barleria buxifolia*) around the grain storage area and also around the crop field[14]**.** These plants being full of thorns, keep rats away from the area. Farmers have experienced that these thorns when spread near the mouth of rat hole completely drive them away.

Powdered faeces of horse

In hills, *Khachchar* (mules) are main carrier of articles. Dried faeces are collected by villagers from road side that grinded into fine powder. The powdered faeces of *Khachchar* is placed at the entrance of mouse hole. Due to its odour, rodents are made to leave that plot. Scientists did not rate it as a rational practice. A similar kind of practice is also reported that farmers were using the excreta of cats to distract rodents out of field[15].

Indigenous storage pest management practices

Sun drying

The grains to be stored are first sun dried by the hill farmers and this kills most pests. Grains of wheat, green gram and black gram are generally sun dried for two days. Storing containers are also dried before putting grains in them. For sun drying, grains are exposed to sun by evenly distributing it on the courtyard. Area marked for this is cleaned properly. Some farmers use mats. Scientists consider it a rational practice since it reduces the moisture content in grains otherwise which forms a congenial environment for insects – pests attack and disease development. During one study, it is recorded 100% mortality of the eggs and first instar larvae of *Callosobruchus moculates* and first instar larvae of *C. subinnotatus* exposed to sunlight for two hour in *Vigna subterranean* (L)[16].

Storing green gram

For storing green gram, a mixture of immature turmeric, dried leaves of walnut and mustard oil is prepared. The mixture is properly pasted on the grains of green gram. This mixture reduces the chances of disease development and also acts as a physical barrier between stored grain insects pests and grains. Some farmers use chalk powder for creating physical barrier. Farmers of Kanpur use mustard oil for increasing storage life of chick pea and pea seeds. They smeared mustard oil on chick pea and pea seeds before storing them[17].

Storing black gram

Hill farmers after drying black gram mix it with mustard oil. Farmers say after this practice, there are

chances of neither disease development nor pest attack. Some farmers store black gram with salt stones in order to prevent pests of stored grains. This kind of practice is also followed in some parts of South India, where farmers for storing grains and pulses keep a handful of rock salt at the base of the storage place[18]. Some farmers are also found to mill the grains of black gram. They say it reduces the chances of storage insect-pests infestation. Before storing seeds of black gram, a very common practice followed by farmers is to mix it with cow urine for protecting it from pests during storage so that it can be saved for sowing in the next season.

***Chullah* ash**

For storing food grains, ash collected by burning of fuel wood is dusted on the heap of food grains and mixed well by hands and then food grains are stored. Scientists considered it as a rational practice as by broadcasting, ash forms a protective coating around the seeds and work as physical barrier between insect pests and grains thereby checks the activity of them. Use of ash from burnt cow dung as an insecticide against *T. casteneum*, *Sitophilous granaries* (L.) and *Cryptolestes ferrugineus* (Stephens) larvae has also been reported[19]. Ashes kill insects by desiccation or by filling the intergranular spaces, restricting insect movement and emergence.

Paddy seeds stored with plant leaves

Farmers have known plants that are toxic in nature and could thus be a viable source of controlling pests. Neem is a very well known example. Similarly, there are hundreds of such plants which have been used by farmers for this purpose. In hills, farmers also use leaves of walnut (*Juglans regia* Linn.) *timur* (*Z. alatum* Roxb.) tree for storing grains and pulses. Specially for storing paddy seed, it is dried for two days just after harvesting then before loading it in storage structure, leaves of walnut (*Juglans regia* Linn.) and *timur* (*Z. alatum* Roxb.) tree are mixed. This practice was considered rational practice by the scientists because it fills the integranular space and hinders the free movement and feeding of pests. In this way, post harvest losses due to insect pests are checked. In Gujarat, farmers incorporate leaves of *Nafatia (Ipomoea fistulosa)* in the sorghum and rice grains which are kept for consumption. It is believed that bitter smell of these leaves protect stored grains against any pest. By this method, grains can be preserved up to a period of one year[20].

Other practices

Besides white grub and rodents, there are other pests which cause damage to the standing crops. Those include aphids and lepidopteron insects, weeds in paddy and finger millet and diseases like blight of onion, wilting in kitchen garden greening of potato, etc. Farmers practiced indigenous methods to control them.

Summer ploughing

The practice of deep ploughing after paddy harvest and leaving land fallow for 10-15 days was found prevalent in the villages. In the month of May–June, farmers plough land with the help of indigenous plough. Depth of ploughing is kept around 30 cm. This ploughing is considered very important by farmers as by this ploughing, farmyard manure and left over of previous crop is mixed in soil. After deep ploughing, land is left fallow so that sunlight can reach at the deepest layer possible. Plant protection scientists considered it a rational practice as a majority of damaging insect pests pathogens harbour in soil. When soil is turned up in the month of May–June and left opens for 10–15 days, these pests are killed due to rupture of their cell wall and over heating as then temperature is around 30°C or more. Turning the soil also promotes parasitic predation in soil and thereby reduces the population of soil borne insects- pests and pathogens.

Ash on standing crop

Ash is predominantly used by farmers in the area for protecting plants. In hilly areas, wood obtained from forest has been major fuel. Ash dust is a product after the burning of fuel wood. The kitchen ash, thus obtained is mixed with the farmyard manure or in pure form applied in the fields and onto plants. It is very effective for insects having chewing and biting mouth parts. When insects come to feed on ash broadcasted plants, ash sticks to their mouth parts and damages them because of which later insects are dead.

Mechanical control

Mahu (aphid) infested plants of mustard, cauliflower and cabbage (*Brassica* sp) are uprooted and buried in the soil to check the spread of insect. For reducing the alternate hosts of pests/pathogens and also breeding spaces for rat cleanliness is maintained around field and bunds are trimmed specially during summers. For avoiding greening of potato tubers, earthen up is done up to one feet height at second weeding. It checks the exposure of tubers to sunlight.

Cow urine and cow dung

Farmers in the study area use cow urine and dung for spraying on diseased plants by making their solution with water as a pesticide. Whenever plants in kitchen garden show wilting symptoms, farmers spray cow urine on them. Some farmers use cowdung solution for controlling onion blight.

Trap crops

Madira or Barnyard millet (*Echinochloa* sp) and *Konri* millet crops are preferred to be sown on the margin of plot instead of middle. Farmers think they attract certain pests when sown on the margin of plot and main crop of paddy is protected. But scientists are undecided about its rationality, they say it provides a fall back option to farmers if paddy fails. It is also reported that for harnessing the benefit of intercropping, some farmers grow a few plants of mustard and thus, leave the *ragi* alone. In addition to this, intercropping of mustard acts as a fall option for farmers if *ragi* fails.

Conclusion

Because of the fragile nature of hills, utilization of traditional wisdom is of paramount importance. Fortunately, in Uttarakhand hills, chemical pesticides have not been popular yet and still farmers rely on indigenous methods of pest management. This is an opportune time to popularize integrated pest management by making cheap and location specific. For this to happen, scientific testing and integration of effective indigenous pest management practices with new science of IPM is necessary. In this era of globalization, organically produced food grains from Uttarakhand can contribute to satisfy the global demand of organic produce and poor small and marginal farmers will be benefited.

Acknowledgement

Authors are grateful to Dean, College of Agriculture, GB Pant University of Agriculture & Technology, Pantnagar for his encouragement and providing infrastructural facilities to carry out the research. Head, Department of Plant Pathology and Entomology are sincerely thanked for their help in validation of certain indigenous methods and the respondents are also gratefully thanked for their cooperation in data collection.

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