

## Application of traditional knowledge and techniques in the control and management insect rice pests in Assam

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### Abstract

Insects are regarded as the most successful group among the invertebrate species due to their adaptation to diverse and harsh environments, varied food habits and their capability to escape from their predators very fast. Besides being beneficial and having positive impact in human life and maintaining ecological balance, many insect species pose negative impact on human life and society as well. One such aspect is that numerous species of insects act as agricultural pests and damage crops, thereby creating much inconvenience to farmers and cultivators in particular and global food security at large. To combat this issue, although application of synthetic pesticides provide quick solution, but in the long run they interfere with the well-being of both aquatic as well as terrestrial ecosystems due to their non-biodegradable property. The practice of agriculture in North East India is not similar with that of the rest part of the country due to its geographical variations, climate and limited access to modern amenities for agriculture. Hence, farmers have to mainly rely on centuries old traditional pest management techniques which is passed to the next generation verbally. The present work is a review of various traditional knowledge and techniques employed by the indigenous farmers and cultivators of Assam to control and manage insect pests of rice.

**Keywords:** insect pest, agriculture and traditional pest management

### Introduction

Invertebrates account for around 73.5% of all the known species present on earth, wherein majority of them are arthropods<sup>[1]</sup>. When the question of survival and adaptability to changing environment among arthropods are taken into consideration, insects are the most successful group in this regard. As a matter of fact, insects constitute more than 80% of all living species on earth and about one million species of insects are known to mankind. The noticeable reasons behind the success of insects are their adaptive capability to varied habitats, diverse food habits, their ability to flee from enemies and predators rapidly and so on<sup>[2]</sup>.

Insects have both negative and positive impact in human life and society. The positive side includes economically and commercially beneficial insects where from products like honey, medicines, silk etc. can be procured. Moreover, many insect species having high caloric value, rich in proteins and other dietary components forms traditional cuisines in many parts of the world, in developing countries and also among many tribes in North East India<sup>[1,3]</sup>. On the contrary, many insects are harmful as well. Many insects are vectors of a number of diseases in humans and animals. They also act as agricultural pests, thereby causing significant damage to crops. Therefore, agriculture and insect pests are interrelated.

India is an agrarian nation where agriculture and allied activities contributes to the primary sector in economy, sustaining the livelihood of nearly 70% population, thereby contributing around 29% of the nation's Gross Domestic Product (GDP)<sup>[4]</sup>. But damage to crops caused by insect pests cause significant loss to economy<sup>[5]</sup>.

The recent trend in global population growth direct the urge to increase production of food grains. But a major hindrance to this effort is brought when nearly 45% yield of food grain

is lost due to insect pests, weeds and plant diseases both before and after harvesting<sup>[6]</sup>. Moreover, the food security Act (2013) of India assures the availability of nutritious food, sufficient in quantity throughout the year. This effort is threatened by the growing population, thereby interfering with the balance between nutrition and food production<sup>[7,8]</sup>. It is also assumed that by 2050, the population of India would increase to 1.8 billion<sup>[9]</sup>. Although India holds a good distinction in the global milk, fruits and vegetables Production, but the per capita accessibility of these essentials is below the need of the family<sup>[10]</sup>.

In modern days, the conventional method to control pest is the use of synthetic pesticides or the adoption of Integrated Pest Management (IPM) which is comparatively better than the former. Although use of synthetic pesticides gives higher yield, but at the same time most of them affect non-target organisms, contaminate water and soil ecosystem, ultimately affecting human health<sup>[6,11]</sup>. Therefore, a switch to alternative solution is extremely important which is environment friendly, biodegradable and sustainable too.

The agricultural practice in North East India is not similar with the mainland India. This is due to the unique physiography and climate of this region. The hilly terrains of North East India is lacking in modern agricultural extension and support system, Even if these services are available in certain areas, the rural community sometimes fail to access them due to transport and monetary constraints<sup>[4]</sup>. Therefore, the farmers and cultivators are compelled to follow traditional methods as an alternative to modern agricultural practice. The practice of applying indigenously developed techniques to manage and control agricultural pests is known as Indigenous Technological Knowledge (ITK) which is generally unique and endemic to any particular society and culture<sup>[12,13]</sup>. This knowledge is generally evolved through trial and error method developed

centuries ago and is disseminated to subsequent generation verbally. There is very few documented literature available in this regard. This article aims to provide information on the various traditional techniques adopted by rice cultivators of Assam to control and manage rice pests without use of modern synthetic pesticides.

### General geographical Features of North-East India and Assam

The North Eastern region of India consists of 8 states viz. Assam Arunachal Pradesh, Manipur, Mizoram Meghalaya, Nagaland Sikkim and Tripura. Total geographical area of this region is 262185 km<sup>2</sup> accounting for 7.9 % of total area of India [14]. This region also holds one of the Biodiversity Hot Spots of the world.

Assam, one of the North Eastern states which is located between 24° 09' N to 27° 58' N latitudes and 89° 42' to 96° 01' E longitudes accounts for 2.4 % of India's land area which is about 78,438 km<sup>2</sup> [15]. Two important rivers-the Brahmaputra and the Barak along with their tributaries flows through Assam. A sub-tropical monsoon climate prevails in Assam where average temperature is 35° C and 7° C in summer and winter respectively [16]. An annual rainfall of 200 to 300 cm is received by the state. The relative humidity is 60-80% [15]. The topographic and climatic factors makes this region very congenial for the growth of paddy. Urban population of the state is 85.90 % whereas only 14.09 % population are urban dwellers. Hence, it can be assumed that agriculture plays a very crucial role in the rural economy of the state.

### Rice cultivation in Assam

Rice (*Oryza sativa*) constitute the staple diet of the people of Assam and other North Eastern states of India. About 54.11% of the land in Assam is devoted to agriculture wherein rice field occupies about 80% of the total

agricultural land [17 18]. Rice alone contributes 96% of total food grain produce of Assam with a gross cropped area of 2.54 million hectare [19]. Assam is also well known for the rich genetic diversity of rice. Based on soil, temperature variation, rainfall and variation in season, there are three rice growing seasons in Assam- Sali or winter variety (June/July to November/December) occupies 68% of rice grown area, Ahu or Autumn variety (March/April to June/July) occupies 18 % of rice grown area and Boro or summer variety (November/December to May/June) occupies 12.9 % of rice grown area [19].

### Insect pests of Rice found in Assam

The most common phytophagous insect pest of rice are rice hispa (*Diuraphis armigera*), rice bug (*Leptocorisia spp.*), thrips (*Stenchaetothrips biformis*), yellow stem borer (*Scirpophaga incertulas*), leaf folders (*Cnaphalocrocis medinalis*), Brown plant hopper (*Nilaparvata lugens*), caseworm (*Nymphula depunctalis*), grasshoppers (*Acrida exaltata*), gundhi bugs (*Leptocorisia spp.*) and whorl maggots [18, 20].

Another survey from Regional Agricultural Research Station (RARS), Titabar of Assam Agricultural University (AAU), Jorhat reported as many as 29 parasitoid species which belongs to 10 Hymenoptera families viz. Vespidae, Ichneumonidae, Braconidae, Trichogrammatidae, Scelionidae, Eulophidae, Pteromalidae, Chalcididae, Ceraphronidae and Bethylidae. Only a single species of dipteran parasitoid from the family Tachinidae was also observed [19].

### Indigenous methods in practice to control and manage insect pests of rice

Following are the popular traditional and indigenous methods applied by the rice cultivators of Assam to control and manage a diverse group of insect pest in rice fields:

**Table 1:** Popular traditional and indigenous methods applied by the rice cultivators of Assam to control and manage a different species of insect pest in rice fields [4, 12, 13, 21].

Sl. No.	Traditional Method/Practice	Target insect Pest	Remark
1	Hanging smashed crabs and frogs on top of bamboo pole in paddy fields	To attract gundhi bugs <i>Leptocorisia spp.</i>	Rotten smell of Crab/frog flesh attracts gundhi bugs instead of rice grains.
2	Spraying solution of fresh cow dung and water in rice fields	Thrips ( <i>Thrips oryzae</i> ) Rice hispa ( <i>Diuraphis armigera</i> )	Odour of Cow dung repels insects. The Nitrogen content of dung helps in revival of damage caused by rice hispa.
3	Erection of long branch of bamboo ( <i>Bambusa spp.</i> )	Rice stem borer ( <i>Scirpophaga incertulas</i> ), Multiple insect species	Birds perch on these bamboo branches and predate on the adult moths of stem borer and swarming caterpillars.
4	Spraying stem decoction (seeds and leaves) of Neem ( <i>Azadirachta indica</i> ) in rice field.	Multiple insect species	Azadirachtin present in kernels and leaves of neem works as growth- retardant and anti-feedant.
5	Kerosene oil impregnated with coconut fibre rope dragged in standing water of rice field	Rice caseworm ( <i>Nymphula depunctalis</i> )	Kerosene serves as toxicant and insect repellent
6	Putting small pieces of black colocasia ( <i>Colocasia esculenta</i> ) in paddy field	Rice caseworm ( <i>Nymphula depunctalis</i> )	Creates poisonous anaerobic condition thereby kills rice caseworms
7	Application of grounded drumstick bark ( <i>Moringa oleifera</i> ) in rice field	Rice stem borer ( <i>Scirpophaga incertulas</i> )	Acts as insect repellent and anti-feedant
8	Placing fern stem ( <i>Cibotium spp.</i> )	Rice stem borer ( <i>Scirpophaga incertulas</i> )	Fern is reported to possess insecticidal property
9	Applying peels of <i>Citrus sinensis</i> (Sakala tenga in Assamese) in the paddy fields	Rice stem borer ( <i>Scirpophaga incertulas</i> )	Acts as insect repellent
10	Keeping cut leaves of Indian rhododendron ( <i>Melastoma malabathricum</i> , Phutikia in Assamese) in the rice fields	Rice stem borer ( <i>Scirpophaga incertulas</i> )	Foul smell of chopped leaves drives away insect pest
11	Placing sliced pieces of pomelo ( <i>Citrus grandis</i> ) in rice fields	Rice stem borer ( <i>Scirpophaga incertulas</i> )	The essential oils present in pomelo drives insect pest away

12	Removing grassy weeds surrounding the paddy field	Rice leaf borer ( <i>Cnaphalocrocis medinalis</i> )	These weeds may otherwise provide good microhabitat for pests
13	Fermenting barb fish or puthi ( <i>Puntius spp.</i> ) by burying them in the soil for two weeks or more thereafter spraying the extracted water in paddy field.	Rice stem borer ( <i>Scirpophaga incertulas</i> )	Fermented extract of fish is a good repellent of rice stem borer
14	Placing Thorny branches of <i>Ziziphus spp.</i> (Ber) in rice fields	Rice hispa ( <i>Dicladisa armigera</i> )	Rice hispa faces problems in movement amidst thorny branches of Ber and gets injured
15	Placing branches of <i>Saccharum spontaneum</i> and <i>Cymbopogon khasianum</i>	Rice stem borer ( <i>Scirpophaga incertulas</i> )	Problem in insect pest movement
16	Keeping branches of <i>Vitex negundo</i> (Posotia in Assamese) on stagnant water	Rice hispa ( <i>Dicladisa armigera</i> ) and multiple insect species	Its intolerable odour acts as insect repellent
17	Applying extract of tobacco leaf	Rice hispa ( <i>Dicladisa armigera</i> ) and multiple insect species	Pungent smell of tobacco repels insects
18	Burning clothes on bamboo sticks and placing in the four corners of paddy fields	To attract gundhi bugs <i>Leptocoris spp.</i>	Attracts gundhi bugs towards light, thereafter they lose their wings and immolate
19	Keeping Clerodendrum viscosum twigs (Kutap in Assamese) in the infected paddy field	gundhi bugs <i>Leptocoris spp.</i>	Leaves acts as insect repellent
20	Mixing excreta and urine of goat, tobacco leaf and spraying in paddy field	Rice hispa ( <i>Dicladisa armigera</i> ), Rice caseworm ( <i>Nymphula depunctalis</i> )	Pungent smell of the mixture repels insect pest
21	Placing cut pieces of <i>A. punduna</i> (Raman beeh in Assamese ) in the field	Rice stem borer ( <i>Scirpophaga incertulas</i> , <i>Chilo suppressalis</i> , <i>Chilo polychrysus</i> , <i>Sesamia inferens</i> )	Insect pest repellent
22	Before the initiation of panicle, burning of fire near the paddy fields	gundhi bugs <i>Leptocoris varicornis</i> , <i>Leptocoris acuta</i>	Attracts gundhi bugs towards light, thereafter they and becomes immolate
23	Rice leaf is crippled before transplanting in fields	Rice stem borer ( <i>Scirpophaga incertulus</i> , <i>Chilo suppressalis</i> , <i>Chilo polychrysus</i> , <i>Sesamia inferens</i> )	Removes eggs of rice stem present on tip of leaves
24	Cut pieces of <i>Sida rhombifolia</i> (son borial vine) in paddy field before tillering	Rice stem borer ( <i>Scirpophaga incertulas</i> ), Rice hispa ( <i>Dicladisa armigera</i> )	The roots of sida hemp is bitter, hence insect pest repellent
25	Burning tyres of bicycle	gundhi bugs <i>Leptocoris spp.</i>	Gundhi bugs are repelled through foul smell emitted from burning tyre

### Conclusion and discussion

It can be concluded that traditional knowledge of agricultural pest management has been in practice among the local rice cultivators of Assam and other North East Indian states of India since ages. Since the materials and methods used to deal with insect pests are organic, hence are ecologically sound, sustainable and do not interfere with the health of environment. These are also cost-effective techniques that involves less sophistication and expertise.

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