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Ethnopathology: local knowledge of plant health problems in Bangladesh, Uganda and Bolivia

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All peoples have names for and knowledge of plants, animals and other things in the real world. An ethnopathology (or, more strictly, 'ethnophytopathology') – study in Bangladesh, Uganda and Bolivia revealed that smallholder farmers label plant health problems with meaningful names. A local name for a plant health problem typically has two kinds of meaning. The first is a literal translation of the name, often a kind of shorthand description of the symptom. The second and most important kind of meaning is the denotative meaning (the thing in the real world which the name actually refers to). Local words for plant health problems often label the symptom rather than the actual disease. This is logical, since smallholders cannot observe microscopic causal organisms. Local concepts for plant health problems do not necessarily classify the natural world in exactly the same way that scientists do, yet local terms for plant health problems are still meaningful. It is not clear if folk classifications of plant health problems are phylogenetic classifications (e.g. 'mammals' vs. 'fish') or ecological (e.g. 'seafood' vs. 'meat and poultry'). Cross-culturally, local knowledge recognizes that plants are alive, and that they may be ill or healthy, perhaps in analogy with human health.

Keywords: ethnophytopathology, folk knowledge, plant disease, symptomatology

Introduction

Plant pathologists and farmers are the two groups of people most interested in plant disease, yet they describe plant health problems in different ways, which could potentially hinder communication. Scientists interested in working with smallholder farmers will understand them more clearly if they grasp a few simple concepts. First, local words for plant health problems have meanings, but the meanings are often symptoms rather than causes. Secondly, a local term has a denotative meaning (what the word refers to in the real world), which must not be confused with the literal translation of the folk term. In this study it was not expected that farmer terms would always translate neatly into scientific categories (e.g. problems caused by several organisms might be lumped into a single term), yet local terms still have clear meanings to local people. Understanding this helps appreciate the rationale behind local knowledge of plant pathology.

There is a long-standing western tradition of giving plant diseases official common names which are often based on the symptoms rather than the causes of a disease (e.g. powdery mildew, damping off, etc.). These are often old names, from medieval or classical times (e.g. rust and mildew, see Orlob, 1973; Zadoks, 1985). Official common names evolved from folk names (at least initially) and bear some resemblances to them: for example the names may be a single word, or they may be a binomial, with a 'specific' word modifying the 'generic' name (e.g. powdery mildew vs. downy mildew).

There are two important differences between official common names and folk names. First, official names are indeed 'official', established by a committee of experts of a professional society, while folk names are conventions of popular use. No one has the authority to change folk names by decree. Secondly and more importantly, official common names are written, while folk names are usually not. As Latour & Woolgar (1986) pointed out, writing is a hallmark of science, from laboratory notes to labels on vials to scholarly publications. Folk names are rarely written down, and usually not by the people who use the system. Therefore a folk classification is limited by what the human memory can recall. Five hundred terms may be near the optimum for any given domain of knowledge (e.g. 500 names of plants, 500 of animals, etc.). By virtue of being written, official common names are free to encompass an encyclopaedic corpus of knowledge which no one person knows. Writing official common names, covering

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disease from many countries, preserves and codifies them beyond what any local system of knowledge could reasonably be expected to include.

Ethnoscience

Ethnoscience is the anthropological study of local knowledge. It includes various subtopics such as ethnobiology (knowledge of living things; Berlin, 1992), ethnobotany (Balée, 1994), ethnozoology (Hunn, 1977), ethnoentomology (Wyman & Bailey, 1964; Posey, 1984; Bentley & Rodríguez, 2001; Gurung, 2003). Ethnoscience has also been used for studies of wild edible fungi (Mapes *et al*., 1981) and for topics ranging from edible wild plants (Addis *et al*., 2005) to soil types (German, 2003).

Ethnoscience observes that local people have 'names for things' (as per Brown & Berko, 1960) and that these names are organized into hierarchical taxonomies (Berlin, 1992). Ethnoscience describes the meanings of folk names, according to the speakers of the target language. These names may or may not correspond to any one category in formal taxonomics. For example, Navajo has a word, *tsís'ná*, which includes bees and flies (Wyman & Bailey, 1964), for which there is no exact counterpart in Linnaean taxonomy.

Cultural relativism expects such differences between languages, yet the natural environment (e.g. biology) obeys certain universal principles. Crops and other plants suffer from ill health in all parts of the world, linked to fungi, bacteria, nematodes, etc. and abiotic causes. The symptoms are similar worldwide; a tomato with *Tomato golden mosaic virus* looks the same in Honduras or in Bangladesh.

There are also cross-cultural similarities in human cognition. For example, people everywhere perceive the same colours, even if they divide the colour spectrum differently (Berlin & Kay, 1999). Words like 'vine', 'herb', 'tree', 'animal', 'bird' and 'fish' are nearly universal, occurring repeatedly and in languages on all continents (Brown, 1984). Human cognition and language and the natural history of the real world place certain constraints on the variability of how local people will perceive and describe plant health problems.

Cross-culturally, plants and animals are classified in taxonomic hierarchies, roughly similar to phylogenetic classifications (Berlin, 1992). However, many anthropologists reject the idea of human universals and seek local exceptions to them. In one such argument Povinelli (1990) showed that the Emiyenggal and Batjemal speakers of Australia classify the same set of animals in not one, but four different systems. One of these resembles a phylogenetic taxonomy, but the others are based on principles of movement, habitat and use. Povinelli's arguments are convincing, but other languages also classify living things in more that one way. Even scientists in the western tradition classify animals in alternative systems. A veterinarian recognizes utilitarian categories such as 'pets,' 'livestock' or 'wildlife', which are based on (human) ecology. In one context a veterinarian may call a dog a 'pet' (grouped with housecats), while in another context the vet may classify the dog as a canine (grouped with wolves and foxes).

Applied entomologists frequently classify insects by their ecology, such as 'pests of rice', which include insects of different orders, fungi and many other organisms with little phylogenetic similarity. The 'guild' of natural enemies of the fall armyworm includes fire ants, various parasitic wasps (from different families), several species of social wasps, a nematode, fungi, bacteria, viruses, etc. Alternative classificatory systems (such as phylogeny vs. ecology) help humans to make sense of a complex world.

Ethnopathology

There has been little work on the ethnoscience of plant diseases. Sillitoe (1996) mentions some folk names for plant diseases among the Wola of New Guinea.

This paper refers to the ethnoscience of plant diseases as 'ethnopathology'. A more accurate term would be 'ethnophytopathology', but the shorter word was chosen.

Many languages seem to have a word for 'disease.' For example, Sundanese-speaking farmers in Java use a word which the anthropologist Winarto (2004) translates as 'pest' for problems where the farmers can see the cause, and another for 'disease' where they cannot see the cause. However, Honduran smallholders have a word for 'insect' (*insecto*), but occasionally also refer to an insect pest problem as a 'disease' (*enfermedad*). In other words, they occasionally use the word for 'disease' to indicate all plant health problems, including insect damage, even when they could observe the insects (Bentley, personal observation).

For animal diseases, in East Africa Catley (2006) found good agreement between pastoralists' and veterinarians' disease names and diagnostic criteria. However, in practice veterinarians often disregard indigenous disease names because they become distracted by the literal interpretation of the name (Catley, 2006). The authors of the present study have also found that agronomists and agricultural scientists who have contact with farmers often know local names for crop diseases, but may not respect them as meaningful. Other works have described a framework for helping local technical people understand the meaning behind the local names for plant health problems (Boa *et al*., 2001; Bentley *et al*., 2004). In an effort to describe local names for the ill-health of crops, research was conducted in Bangladesh, Uganda and Bolivia, as described below. It is hoped that this description will show that folk names for plant health problems are logical and orderly, and that this will help plant pathologists and others who work with rural communities to appreciate local knowledge of plant pathology.

Materials and methods

Bangladesh

In 2003, Bentley and Kelly taught a short course which included practical exercises for about 16 participants, who learned how to interview smallholder farmers and

describe their categories of plant health problems. This process consisted of, first, identifying the word for each plant health problem and writing it out in both Bengali and Roman ('English') letters. Secondly, the word was translated literally into English. Thirdly, the meaning of the term was defined denotatively (i.e. what thing(s) in the real world it labels).

Harun-Ar-Rashid, a senior soil scientist who took the course, then applied the method in village meetings, with a team of people from the NGO Agricultural Advisory Society (AAS), which he directs. AAS hired Murshedur Rahman, a young entomologist, to help with the work. They held meetings in 35 villages, in three areas of the country (Natore, Norsingdi and Moulvibazar), during three successive cropping seasons: summer-I, summer-II and winter, 2004. The team interviewed 1591 farmers about 165 problems in 22 crops.

At each meeting a facilitator explained the study and the need to understand the local plant health problems. The villagers made a list of their crops and the main problems in each one. Each local person was then assigned a plant which he (or she) collected in a nearby field. In a plenary session each participant explained the plant health problems, using the fresh plants as visual aids, while the researchers took notes. After a great deal of work, an enormous amount of detail was collected (Harun-Ar-Rashid *et al*., 2006).

The researchers and the farmers were all native speakers of Bengali, so they understood each other clearly. Over 3 days, Bentley helped the team to transcribe all of the folk terms into a Roman script ('alphabet') based on the IPA (international phonetic alphabet).

After the field work, various colleagues, including some of the top agricultural scientists in Bangladesh, helped to identify probable causes based on symptom descriptions. For the full report see Harun-ar-Rashid *et al*. (2006).

Uganda

In 2003, Boa showed some of the Bangladesh reports to Kabeere, an agricultural scientist recently retired from NARO (National Agricultural Research Organisation). Based on her considerable field experience, Kabeere replicated the method in Uganda, with Luganda-speaking villagers. Kabeere held meetings in two villages (Kikakanya and Buwoya) in Mukono district in September 2003. In November 2004 she met with a group of farmers from five parishes near Goma, Mukono. Including the villages and the group meeting, Kabeere interviewed 67 farmers about 41 problems in six crops. Immediately after each meeting, she consulted with many plant health experts in Uganda and obtained good denotative descriptions of the various local terms. For the full report see Kabeere *et al*. (2006).

Bolivia

In 2006, Bentley (anthropologist and long-time resident in Bolivia) asked Bolivian agronomist Herbas (from the Proinpa Foundation) to make three field expeditions over three different seasons to interview farmers in Quechua (a native American language spoken in the Central Bolivian Andes) and to document local knowledge. The first experience was quite promising, since Herbas speaks excellent Quechua and had some 17 years' field experience with local plant health problems, with access to taxonomic specialists when needed. The interviews were held in farmers' fields, in several communities near Toralapa, Cochabamba, not in village meetings, reflecting the dispersed settlement of the area. Farmers were busy sorting seeds and planting potatoes, broad beans and other crops. They used the seeds (and occasionally the irrigated crops) around them as visual aids to describe their crops' health problems. Bentley speaks enough Quechua to transcribe the local terms. In August 2006, Bentley and Herbas visited 16 individual farmers and one group of about 30 farmers. Two of the farmers were visited twice and the others once. Interviews covered 32 folk categories of problems in four crops (potatoes, barley and other grains, broad beans and apples). Unfortunately, Bentley and Herbas did not return to the field for the mid-cycle and harvest seasons, so their study missed the plant health problems which appear during the main part of the cropping season. For the full report see Bentley & Herbas (2006).

Results

Local names for plant health problems have two kinds of meaning. First, many can be broken down into smaller, meaningful parts. They are a kind of shorthand description for a creature or symptom. For example, in Luganda, *kuwumba* 'to make powder' is the local name for various weevils that attack sweet potatoes and other crops, turning them to dust. The folk name is a clear reference to the damage, and is a no-nonsense way to name this pest. A single folk name may apply to different problems. For example, there are *kuwumba* (weevils) making powder out of sweet potatoes, maize and beans. The farmers are not confused; they know these are different weevils, but the local name emphasizes that the insects are similar and cause similar damage in different crops.

The second kind of meaning is that the local names refer to something. Continuing with the weevil example, *kuwumba* in sweet potato are *Cylas brunneu* and *C. puncticollis* (two species of the same genus), *kuwumba* in maize are *Sitophilus zeamais*, and *kuwumba* in beans are *Acanthoscelides obtetus* and *Zabrotes subfaciatus* (two different genera). In other words, folk names may label groups of organisms, as do scientific names (Table 1).

Causes

Although local people are interested in preventing and curing plant health problems, there is little indication that they are concerned with causes (e.g. Trutmann *et al*., 1996). However, farmers may attribute problems to moisture, wind, etc., which indeed may contribute to the spread or

Table 1 Examples of literal translations and denotative meanings of local names for plant health problems in Uganda, Bangladesh and Bolivia

Local term	Literal translation	Denotative meaning
Uganda		
Kuwumba	To make powder	Various weevils that attack sweet potatoes and other crops and turn them to dust
Kubabuka	Scorch	Damage by *Phytophthora infestans* and *Alternaria solani* in tomatoes
Okugengewala	To become a leper	Disfigured leaves with white chlorotic spots associated with various viral diseases, e.g. on bean (common mosaic), cassava (mosaic) and sweet potato (feathering mottle and chlorotic virus)
Ekitiko	Big ugly mushroom	Maize smut (*Ustilago maydis*)
Obusilinganyi	Many tiny earthworms	Nematodes
Bangladesh		
Bau laga	Bad wind	Rice leaf blight and bakanae
Pocha rog	Rot disease	Various diseases including leaf blight of tumeric, leaf blight of potato, sheath blight of rice
Pata dag rog	Leaf spot disease	Mango anthracnose
Jhora rog	Dropping disease	Mango anthracnose
Morok rog	Dying disease	Late blight on potato leaves
Pocha morok	Rot disease	Late blight on potato leaves
Bolivia		
Ch'uñasqa	Turned to *chuñu* (potatoes freeze-dried in the high Andes)	Potatoes literally frozen in storage
Jullu	Unanalysable[a]	Bacterial wet rot in late-blight-infected potato tubers
Musuru	Unanalysable	Maize smut (*Ustilago maydis*) and by analogy other diseases e.g. peach leaf curl (*Taphrina deformans*)
K'anura	Unanalysable	Dry corky rot of potato tubers caused by *P. infestans*
Ch'aki k'anura	Dry k'anura	Dry rot of stored potatoes, possibly caused by *Fusarium* sp.
Mancha chocolatada	Chocolate spot	Chocolate spot in broad beans. Spanish common name probably derived from English common name

[a]An unanalysable word has a clear meaning, but it cannot be broken down into smaller, meaningful parts. For example the English word 'grasshopper' can be broken down into meaningful parts (grass, hop and –er), but 'grass' cannot and is therefore unanalysable. Unanalysable words are some of the basic semantic building blocks of a language.

development of disease. Leaf blight and bakanae of rice in Bangladesh may be called *bau laga* (bad wind) and Bangladeshi farmers attribute dieback in eggplant to wind.

Farmers may also realistically recognize an abiotic cause for a plant health problem. In the high Andes seed potatoes can literally freeze in storage, which farmers call *ch'uñasqa* (which is difficult to translate, but roughly means 'freeze-dried.').

Farmers may also have notions of disease contagion, e.g. noticing that diseases enter or move into crops. In Bolivia *jullu* refers to wet rot in potato tubers, caused by soft rotting bacteria following infection by the oomycete *Phytophthora infestans*. It is an explicit disease name, not a general word for rot (*ismuy* means 'to rot'). As she sorted seed potatoes for planting, Feliciana Mérida explained, "*Jullu* enters in the field. Sometimes a lot. It rots more in the flat country than up here on the slopes, and it rots more in the field than in the house (after harvest)". Bolivian farmers also said that the folk disease *k'anura* (a kind of dry rot) could be in the soil.

In at least one case, one causal organism was linked to several folk diseases in the same crop. Potato late blight is called *t'ojtu* (or *lluphi* or *k'asparillo*, literally 'scalding' or 'burning') when the disease attacks the leaves. When the disease attacks and breaks the plant's stem it is called *p'aki p'aki* ('repeated breaking'), while a bacterial wet rot of blighted tubers is called *jullu* (see paragraph above) and a dry, corky rot (when bacteria are absent) is called *k'anura*. All four of these conditions are caused directly or indirectly by *P. infestans*, although there is no indication that farmers think of them as related.

Symptoms

The local terms for plant health problems are often symptom names, that is, they label symptoms, not the causes of disease. This explains why *pocha rog* ('rot disease') in Bengali labels diseases as diverse as anthracnose of bean, late blight of potato, sheath blight of rice and leaf blight of tumeric. The names themselves are often shorthand symptom descriptions, e.g. Bengali *pata dag rog* ('leaf spot disease') or *jhora rog* ('dropping disease'), to describe mango anthracnose. Most ancient disease names also came from symptoms (e.g. 'rust' because of the colour), while some names were also related to the (supposed) cause and the affected plant part (Orlob, 1973).

The Luganda word *kubabuka* comes from the verb 'to scorch' and refers to the damage caused by *P. infestans* (late blight) and *Alternaria solani* (early blight) in tomatoes. Also in Luganda, *okugengewala* (to become a leper) refers to the disfigured leaves with white, chlorotic spots associated

with various viral diseases on bean (common mosaic), cassava (mosaic) and sweet potato (feathery mottle and chlorotic virus).

Even though folk names for plant health problems may label discrete symptoms most of the time, they don't always. In Bolivia, a farmer, Edwin Mérida, described how chocolate spot in faba bean (Spanish: *mancha chocolatada*) progresses. He said that the leaves get blisters on the undersides. The blisters (Quechua: *phusullus*) fill up with water, like a balloon, which bursts and then the rest of the leaf dries (E. Mérida, personal communication). The balloon analogy comes from the Bolivian carnival, when people have play fights with water balloons. Mérida explained that the blisters form on the leaves until the flowers drop and the crop is lost. He knew that the disease had several symptoms, which progressed in a predictable way. When a disease is important, easy to observe, and progresses from one symptom to the next, farmers may develop a concept for the disease that goes beyond a single symptom; in Honduras farmers have a detailed appreciation of maize ear rots, including symptoms and notions of cause and control (Bentley, 1990).

Binomials

Local terms are often binomials, like Linnaean species names. This is not too surprising, since Linnaeus' idea for scientific binomials came from his study of Lapp folk knowledge. What is not obvious is that such binomials occur not just in folk terms for plants and animals, but also in local terms for plant health.

There is some variation between languages. Bengali uses many binomials. The second term often carries little semantic weight. For example *rog* ('disease') occurs often in disease terms, adding little new meaning to the term. Because of this added or extra word, Bengali folk terms are occasionally three words long.

Bengali and Quechua both happen to link adjectives and nouns much like English does (the first word is an adjective, followed by a second word which is the noun). However, Luganda is an extreme prefixing language. A phrase which might be eight words long in English may be rendered as a single long word in Luganda. Adjectives in Luganda may be prefixed to the noun in a single word. For example, maize smut is called *ekitiko* (big ugly mushroom) from *eki-* (big, ugly) and *–tiko* (mushroom).

For unknown reasons, many of the disease names in Quechua are not descriptions, but are one-word folk genera, i.e. the basic words of the lexicon. For example, in English 'duck' is a folk genus. 'Duck' just means 'duck' and is not derived from another meaning, nor is it built up of smaller words with other meanings. In the same way, in Quechua *musuru* just means 'smut', especially in maize, although it may be used to label smut in other cereals, or even the reddish swelling caused by the fungus *Taphrina deformans* in peach leaves. *K'anura* is also a Quechua word and a folk genus; it labels certain dry rots. However, *k'anura* can also be modified by a species name, e.g. *ch'aki k'anura* ('dry k'anura', referring to dry rot of stored potatoes, possibly caused by *Fusarium*).

A language may have several scores of terms for describing plant health problems, but still farmers occasionally mention problems they cannot label, like the Bolivian farmer interviewed who said simply that his apples were not producing (S. Zapata, personal communication), or the Ugandan farmers who described streaks in tomatoes, and tomatoes that were not growing, although they had no names for these conditions. This situation is especially common with plant health problems that are new or unusual.

Classification systems

It is not clear if these local systems classify 'plant health problems' as living organisms or not. There is little evidence that the smallholders interviewed for this paper think of diseases as being caused by living things (such as fungi). Indeed, they often say that fungal diseases are caused by moisture (Bentley, 1991; Trutmann *et al*., 1996). After all, microscopic organisms are not observable to these small-scale farmers, and even in applied western science, the poor health of crops does not necessarily have a living cause, but may be the result of water, soil or weather conditions, among others.

It is not clear from this study if the folk terms for plant health problems can be arranged hierarchically. As in most folk classifications, ethnopathology presents many binomials (folk species), e.g. 'late blight' or 'early blight' and one-word, basic terms (folk genera) e.g. 'blight' or 'pox'. However, it is not obvious that these terms are ordered into other, superordinate categories. When describing the ill health of plants in general, Quechua speakers use terms like *onqoy* ('to be diseased') or *onqosqa* ('ill', 'illness'). When farmers notice a disease for the first time they may call it a *mosoj onqoy* ('new disease'), much like plant pathologists. For folk and formal systems alike, 'disease' can be used to label the ill health of humans, animals or plants.

Bengali refers to damage as *rog* ('disease') even if the cause is an insect. Fruit and leaf beetles in banana are *poka* ('insects'), but their damage is called *rog*.

From an earlier study it was learned that there is not really a word for 'weeds' in Quechua. A weed in general is called *qhora* (and even *qhoray*, 'to weed'), but *qhora* also means any small herbaceous plant, not necessarily a harmful one (Bentley *et al*., 2005).

Borrowing from the larger society

Redfield (1962) noticed that peasant communities were part of larger societies and that ideas flowing from city to countryside were part of the worldview of rural people, who were linked to cities (as the vast majority of people now are). World religions such as Islam and Christianity are shared by smallholder farmers and city people. Rural people may also borrow and rework terms from cosmopolitan science. Trutmann *et al*. (1996) observed that farmers in the Great Lakes region of Africa borrowed the concept of 'vitamin' to describe plant health.

In Bangladesh, farmers use the term 'virus' to describe certain plant health problems, especially yellowing or leaf curl. Note that they have borrowed the word for virus, without taking on board all its scientific meaning. A disease they call 'virus' is not necessarily caused by an actual virus, *sensu strictu*. Also 'septic' has been borrowed for stem or root rots, and 'cancer' is used to describe various lethal diseases. Once a word is borrowed from a language it can lose its original meaning. English speakers say 'aniline dyes' with no recollection that '*nil*' is actually the Bengali word for 'blue.'

In Luganda *obusilinganyi* ('many tiny earthworms') seems to have been introduced by extension agents to describe nematodes, which the farmers cannot actually see, but local people now know and use the word.

As the 'virus' example suggests, each of the study languages here is in contact with at least one other, more cosmopolitan language (Luganda and Bengali with English, and Quechua with Spanish), but the relationship between Quechua and Spanish is older and deeper than the relationship between English and Bengali or Luganda. The folk terms for plant health problems from Bolivia are loaded with borrowed Spanish words. Actually, rural people in central Bolivia tend to use the same set of words to describe plant health, whether they are speaking Spanish or Quechua. For example, even when speaking Quechua, farmers call 'chocolate spot' by its Spanish name *mancha chocolatada*, which no doubt was derived from its English name.

Regional synonyms

In Bangladesh, the dataset is large enough to show regional synonyms. Something may have different names in different places, the way that a 'biscuit' in America is called a 'scone' in Britain. Potato late blight may be called *morok rog* ('dying disease') in Norsingdi, but *pocha morok* ('rot death') in Moulvibazar.

Had more data been collected in Bolivia and Uganda, regional synonymy would no doubt have been found there as well.

Similar names for different diseases

In all natural languages a word may have more than one meaning, or sense; these meanings are often related to each other, like links on a chain (e.g. 'a rotten apple' vs. 'a rotten president'). Native speakers understand that a rotten politician may be perfectly healthy physically, yet there is something wrong with his behaviour.

In the same way, one folk name may refer to various plant health problems, which local people understand to be different. For example, in Bolivia *yuraj khuru* (literally 'white insect') labels the larvae of the Andean potato weevil, known for generations, as well as the larvae of the newly introduced tuber moth *Paraschema detectendu*. The two insects are easily distinguished and people are not fooled by the name, although both creatures are white. If the tuber moth remains a pest for much longer it may acquire a unique local name.

On the other hand, because causal agents of diseases are nearly always impossible for local people to determine unaided, folk names may label large groups of diseases with a single name. For example, fungus wilt and bacterial wilt of banana are both called *kiwotoka* in Luganda; *kiwotoka* simply means 'wilt'. As noted above, in Bangladesh at least four diseases in four crops are called *pocha rog* ('rot disease'). More research is needed to determine if the native speakers actually confuse these diseases, or if they recognize that they are different forms of rot.

It is logical to have some words with broad meanings. Bengali, Luganda and Quechua all have a word which means something like 'aphid' (as does English). Only a specialist actually needs a word for each species of aphid, and if necessary, they can be distinguished by context (e.g. 'The aphids on my peach trees have died but my cabbage aphids are worse than ever.'). Having one word for separate but similar problems may help keep the vocabulary concise and easy to remember, without confusing the native speakers.

Identifications of diseases

Tables 2–4 summarize the identifications of the folk names. Many of the unidentified names are for diseases (rather than for insects). In part this is because farmers understand more clearly the causal link between insects and plant health problems, while knowledge of the link between causal agents and diseases is weak.

There are many more unidentified diseases in Bangladesh than in the other two countries. This is because the team in Bangladesh collected many folk names before consulting with plant pathologists, who could not identify most of them based merely on descriptions of the symptoms. In Uganda and Bolivia fewer disease names were collected, but the Ugandan plant pathologists were consulted much sooner, and were closer to the field, so they were able to identify more of them. In Bolivia the researchers were familiar with most of the diseases and could identify most of them in the field.

However, there were cases in all three countries where the teams could not identify the cause of the plant health problem (in technical semantic terms, the denotative meaning could not be defined). This is something to be aware of in future studies: identifying the causes of plant diseases is highly technical, and accurate accounts of folk pathology will probably need to involve teams of plant pathologists and linguistic anthropologists (and perhaps other specialists as well).

Discussion

The methodology of the study is far from simple. To fully apply it, the researcher must be a native speaker of the target language and a general expert on local plant health. Teams of researchers are usually necessary in order to gather all of the necessary expertise.

Table 2 Number of folk names and problems by crop and cause[a] (Bangladesh)

Crop	Folk names	Identified	F	M	V	I	N	P	Unidentified
Banana	8	4	1		1	2			0
Betel vine	8	2	2						4
Bitter gourd	6	2				2			1
Black cumin	1	1				1			0
Bottle gourd	18	4	1		1	2			8
Cabbage	7	3	1			2			0
Carambola	1	0							1
Cauliflower	9	3	1			2			2
Chilli	16	3	1			2			8
Coconut	10	1				1			8
Country bean	24	7	2			5			2
Cucumber	16	4		1	1	2			4
Eggplant	26	7	1			4	1	1	4
French bean	1	1							1
Garlic	7	4	2			2			2
Groundnut	4	3				3			0
Guava	2	2		1		1			0
Hog plum	1	1				1			0
Jackfruit	10	2	1			1			1
Lemon	8	4	3			1			0
Lentil	1	1	1						0
Mango	7	3	1			2			2
Melon	2	2			1	1			0
Mung bean	3	1				1			0
Mustard	1	1				1			0
Okra	6	1				1			0
Onion	7	4			1	3			3
Papaya	3	1			1				0
Pointed gourd	3	3				3			0
Pomegranate	8	2				1			1
Potato	12	4	1		1	2			2
Red amaranth	4	2	1			1			0
Ribbed gourd	4	1				1			0
Rice	26	11	4			7			1
Snake gourd	1	1							1
Spinach	2	1	1						0
Sugarcane	7	2				2			2
Sweet gourd	12	2			1	1			3
Taro	2	1				1			1
Teasle gourd	16	2				2			4
Tomato	11	4	1		1	2			3
Tumeric	2	1	1						0
Wheat	1	1	1						0
White gourd	6	4				2			1
Wood apple	3	3				1			0
Yard bean	20	6	2			4			0
Totals	123	30	2	9	73	1	1	70	123

[a]F, fungus; V, virus; I, insect; M, mite; N, nematode; P, phytoplasma.

Table 3 Number of folk names and problems by crop and cause[a] (Uganda)

Crop	Folk names	Identified	F	B	V	I	N	M	Unidentified
Banana	16	10	3	1	1	3	1	1	4
Bean	13	7	1	0	1	5	0	0	1
Cassava	9	7	2	0	1	4	0	0	1
Maize	11	6	1	0	1	4	0	0	2
Sweet potato	11	7	1	0	1	5	0	0	2
Tomato	20	10	1	1	1	7	0	0	6
Totals	80	47	9	2	6	28	1	1	16

[a]F, fungus; B, bacterium; V, virus; I, insect; M, mite; N, nematode.

Table 4 Number of folk names and problems by crop and cause[a] (Bolivia)

Crop	Folk names	Identified	Ab	A	F	I	P	Unidentified
Apple	4	2		2				2
Barley	1	1			1			
Broad bean	6	3				3		
Oat	1	1			1			
Potato	27	12	1	1	2	7	1	
Wheat	1	1						1
Totals	40	20	1	3	4	11	1	3

[a]Ab, abiotic; F, fungus; I, insect; P, phytoplasma; A, animal (people, birds, mice).

The data is tedious to gather and to check. In future studies of ethnopathology, a team should: (i) work in several villages, perhaps six to eight, although 30 is too many; (ii) try to confirm each observation in the field; for example, if one person identifies a plant health problem as 'red spot' ask several other informants as well; and (iii) work over several seasons, at least three times during the crop cycle, to see many problems from different times of year.

It is not clear from the dataset of this study if folk classifications of plant health problems are taxonomic, like a phylogenetic system (e.g. animals and plants) or if they are ecological (e.g. 'seafood' vs. 'meat and poultry'). It is tempting to conclude that ethnopathology is a pragmatic, ecological classification, in analogy with applied western concepts of 'pests' and 'natural enemies.' When farmers were asked to describe plant health problems, they mentioned insect problems and diseases in roughly equal measure, yet they also seem to distinguish between them, e.g. having separate names for 'insects' and for 'diseases'. Further study is needed. In all three countries insect adults were frequently given different names than their larvae (see Hunn, 1982). This is because local people are often unaware of how insects reproduce (Bentley & Rodríguez, 2001).

In an earlier study (Bentley, 1991) the Honduran folk pathology concept of *hielo* (literally 'ice') was shown to correspond to the yellowing of crop leaves, potentially caused by dozens of pathogens. In the present study, the authors expected to see similar examples, but did not. However, plant pathologists in Honduras chose *hielo* for the anthropologist to study because they already knew that the concept was complicated, so it may be a slightly unusual case. Not every local name for a disease category need have 30 causes.

In Bolivia the potato has four folk diseases caused by a single agent, *P. infestans*. This also merits more study. A folk concept may or may not correspond neatly to a scientific concept, although the folk term can usually be couched in terms that are scientifically meaningful (e.g. 'yellowing of bean leaves', or 'corky rot of potato tubers caused by *P. infestans*').

Local knowledge does seem to recognize that plants are alive, and that they may be ill or healthy, in analogy with human health (Sillitoe, 1996; page 251). This is an over-generalization which merits further study. There may be counter-examples, some based on real-world observations (e.g. that insects are more harmful to plant health than to human health, mosquitoes notwithstanding).

Like plant pathologists, farmers are an occupational group highly interested in plant health problems. When smallholder farmers were asked about plant health problems, they consistently responded thoughtfully, showing diseased plants, explaining the names and discussing the symptoms. Sometimes they asked for advice on management, but they were always eager to discuss the topic. Folk names for plant health problems are often a kind of shorthand description of the symptoms, which is logical enough. Sometimes they are unanalysable, suggesting that they are old words that have been in the language for a long time. Smallholders may not understand all of the causal agents of plant disease, but local knowledge of and names for plant health problems are meaningful and practical. Learning their local meanings is a useful entry into dialogue with the largest and most important occupation on Earth. For example, plant pathologists interested in conducting a surveillance of plant health problems in a tropical country may use local farmer reports of disease to complement other data on the geographical and historical spread of a disease, but only if the plant pathologists understand the meanings of folk names for disease.

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