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Assessing Vegetable Farmer Knowledge of Diseases and Insect Pests of Vegetable and Management Practices Under Tropical Conditions

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In order to understand management of vegetable pests under tropical conditions farmer knowledge of pest etiology and epidemiology were investigated in March 2009. About 78% of vegetable farmers were men aged 31-40, with 51% having little formal education. About 21% of farmers can identify diseases and 16% can identify insects. Over 80% grow susceptible varieties. Ninety-two percent of farmers used synthetics pesticides. About 92% were willing to accept resistant varieties. This willingness provides a basis for further collaboration to employ resistant varieties and promotes integrated pests management.

Keywords: Cameroon, chemicals, crop production, pesticide

Acknowledgements

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resource persons and vegetable research partners of the Catholic Rural Animation Center Bertoua, Ashu A. Tambe of the Center for Assistance to Sustainable Development at Ebolowa, Thiery Tsou Fematouo of Centre Internationale de Promotion et de Recuperation in Yaounde and Institut de la Recherche Agronomique pour le Development in Foumbot and Ekona who facilitated the work by making contacts with farmers and creating a conducive atmosphere for the study.

A minimum consumption of 200 g/day/person, 73 kg/person/year, of vegetables is recommended (FAO, 2004). Presently vegetable availability is 50 kg/person/year and in sub-Saharan Africa (SSA), vegetable consumption is only 43% of recommended rate (FAO, 2004). Vegetables are important sources of micronutrients and provide farmers with higher income·ha^{-1} than cereal, root and tuber crops (AVRDC, 2006).

Vegetables form part of a healthy diet because they provide vitamins and minerals. Biotic and abiotic factors are among the major constraints of vegetable production. Many tropical locations receive high rainfall per year that contributes to high disease incidence on vegetables (Bowen and Kratky 1982). Rain, heavy dews, warm temperatures and dry climates (mostly for insects whose infestation is affected by rain) have been reported as principal conditions that favour establishment of pests (Landston and Eaker, 2009). Iwuchukwu and Uzoho (2009) indicate that the most important financial constraints associated with vegetable production in Enugu State, Nigeria were caused by the labourious nature of vegetable production and incidence of diseases and pests. Youdeowei (2002) also indicated that biotic constraints caused significant economic loss on vegetable in Ghana. In Cameroon, pests and diseases have been identified as major constraints to vegetable production (Ellis-Jones et al., 2008). Pest and diseases cause both economic and health problem to vegetable farmers.

Chemical control is practiced by farmers for higher gains (Gerken et al., 2001), but these pests can become resistant to chemical insecticides very quickly. Moreover, the misuse of chemical insecticides in terms of quantity applied or in dangerous combinations (Obeng-Ofori et al.2002) have created problems which include pest resistance, resurgence of pests, pesticide residues, destruction of beneficial insects and environmental pollution (AVRDC, 2003b). A survey of pesticide application in Cameroon conducted by Matthews G. (2003), to manage crop pests and diseases reported illnesses caused by the use of pesticide. In a resource poor farming system, strategies for pest management become more complicated. The sociological diversity in Africa contributes to disparate traits farmers' value in varieties grown. It is necessary to understand why farmers continue to use certain crops and cropping practices before suggesting improvements in management of pests (Kiros-Meles and Abang, 2007).

This study was undertaken to determine knowledge of pests and diseases, and their management and determine socio-economic demographics of producers. Specifically, the objectives were to determine farmers' experience in pest and disease identification, management, and information needs. The data varied due to differences in knowledge, understanding, sex, age, family status, and level of education (Caulkins and Hyatt, 1999).

Materials and Methods

Sampling sites were in vegetable production regions and determined by use of multi-location random sampling. The sample size for each region was determined based on its share of total national vegetable production. The regions surveyed, and sample size, were: Northwest (21 farmers); West (49 farmers), Southwest (34 farmers), Center (38 farmers), Littoral (19 farmers), South (18 farmers) and East (15 farmers). The AVRDC crops used in the Vegetable Breeding and Seed System program were: *Amaranthus* spp. (Amaranth), cabbage (*Brassica oleracea* var. *capitata* L), pepper (*Capsicum* spp.), Onion (*Allium cepa* L.), Jute mallow (*Corchorus olitorius* L.); African nightshade or Huckle berry (*Solanum scabrum* Miller), eggplant (*S. melongena* var. *esculentum* Nees); tomato (*Lycopersicon esculentum* L.) and Okra (*Abelmoschus* spp.). Tools used to obtain information about farmer perception and knowledge related to vegetable crop pests were open-ended questions administered in a semi-structured questionnaire allowing data to be gathered in the farmer's cultural context (Björnsen-Gurung, 2003). The questionnaire contained 38 main questions. Ten farmer subjects participated in the pre-study (pilot study) to insure farmer comprehension of typical questions; and the ability of enumerators to administer it. Their responses were used to improve the final copy.

A codification manual was prepared and numbers ranging from 1 to 6 assigned to responses, depending on numbers of responses expected per question. This codification was used to enter responses of farmers in the CSPro (census and survey data processing system) software (ver. 3.3, Census Bureau and ICF Macro, Washington, DC). The data in CSPro was imported into SPSS (Statistical Package for Social Sciences) software (ver. 17.0.1, Chicago, III) for

editing and analysis and Excel (ver. 2003, Microsoft Corp., Bellingham, Wash.) was used to produce figures. Descriptive statistics were used to determine frequencies of responses.

Results

The total number of farmers interviewed was 194; 96% of them produced vegetables for market, and 4% produced for both the market and for home consumption. About 64% produced vegetables in rural areas, 32% in peri-urban and 7% in urban areas. The categories of vegetable farmers varied between age, sex, family status and level of education (Fig. 1). Seventy-eight percent of vegetable farmers were men and 22 % women. Most (77%) were household heads and 23% were not.

Experience in crop management

Tomato, hot pepper, okra, and cabbage are important regional crops in Cameroon (Fig. 2) which are produced in different locations (Table 1). Producer experience in vegetable cultivation varied (Table 2). All land holdings were small (Fig. 3).

Knowledge of insect pests and diseases

All famers recognized the so-called “mildiou” (Late blight) caused by *Phytophthora infestans* (Mont.) de Bary, of tomato; the soil-borne bacterial wilt caused by *Ralstonia solanacearum* (Smith) on most solanaceous species and aphids which they can describe by symptoms on crops. The term "flies" was used as a general name for all insect pests that fly; they were able to differentiate between white flies and flea beetles from their color. Most defoliators and fruit

borers were generally called caterpillars, which could only be differentiated from feeding habits described by the farmer. Only 18% of respondents were able to identify vegetable pests. When all pests were placed on the same scale, insect pests appeared to be more important than diseases (Table 3). According to respondents eggplant and Jute mallow did not have serious insect-pest problems.

About equal numbers could, or could not, identify sources of pests and diseases on their farms (Table 4). Generally they could not predict disease outbreaks. They recognize disease problems when they can describe symptoms or when it is necessary to abandon fields for new sites. Generally they believed that all pests and disease problems in vegetable fields are not new. Most grow susceptible varieties and few stated that production of some vegetable crops and cultivars declined, or were not able to be produced, as a result of pest or disease problems. The varieties cultivated are not resistant. However, almost all respondents were willing to accept resistant varieties provided varieties have important traits (Fig. 4).

Pest management practices

Most used synthetic pesticides against fungal diseases and insect pests (Fig. 5). Producers recognized that a number of methods exist for control of insect pests and diseases other than chemical pesticides (Table 5). Sixteen percent of farmers know about natural enemies of insect pests. Insects identified by farmers as beneficial natural enemies were: ants, bees, black ants, butterflies, crickets, ladybird beetles, praying mantis, snails, spiders, and wasps.

Information needs

Most respondents did not have access to information about integrated pest management, pesticide use and safety, or insect and disease identification (Table 6). The vegetable growers depend on experience of others for advice to manage pests and diseases (Table 6).

With a high rate of use of pesticides, 92% of farmers declared their willingness to adopt measures that would reduce pesticide use. Some measures proposed include use of wood ash, resistant and tolerant varieties, proper field management, and appropriate pesticides application. Other methods included good fertilization, use of bio-pesticides and crop rotation. If seed of resistant or tolerant varieties were available to farmers, almost all (92%) would adopt their use.

Discussion

Hovorka (2005) reported that urban agriculture is an important source of food and jobs in Botswana. This was not the case in this study as more farmers were in rural areas, although most inland valleys in cities were locations of vegetable farms. Most vegetables are produced in rural area and peripheries of cities where resource-poor and less educated farmers are found. This could be the reason for the low level of farmer knowledge of vegetable pests and diseases, and management methods. Most farmers were men as was the case in Botswana (Obopile et al., 2008) where agriculture is not considered an activity for women. However, Ratta (1993) reported that women in some developing countries farm; men manage income-generating activities; women manage vegetable production. Ratta (1993) further stated that farming is a viable alternative to waged labor for women who lack access to formal employment due to limited

education, training and other opportunities. Less than 50% of farmers completed at least primary school; fewer completed secondary school and level of education impacted awareness and effectiveness of technology information by vegetable farmers (Elizabeth and Zira, 2009). Socioeconomic characteristics of vegetable farmers in Nigeria indicated that 78% attended through primary school corroborating our findings that most farmers are less educated. This confirms the conclusion by Ratta (1993) that farming is a viable alternative to waged labour for those who lack formal employment due to limited education.

All producers were small land holders as was also determined by Elizabeth and Zira (2009). Autissier (1994) indicated that vegetable cultivation is production of annual plants (shrubby or herbaceous) in a delimited agrarian space, generally exploited intensively. The use of small size vegetable farms could be a result of the intensive nature of vegetable production, and the high cost of chemical inputs which increases cost of production. In addition, lack of adequate knowledge of vegetable production, and protection from biotic, and may be abiotic constraints could prevent vegetable farm size from increasing. Reduced size of the area enables resource poor farmers to effectively their production.

Pests and diseases are important constraints to vegetable production in the tropics. Insect pests are more important in the dry season; diseases are more problematic in the rainy season. Humidity and soil-borne diseases, and climate change, are reasons for pest and disease pressure (Mossler and Dunn, 2009). Despite the influence of moist warm climates on vegetable pest severity most farmers grow vegetables in all seasons; in the rainy season water is available and high income is generated from vegetable production.

Blight, mildew and wilt were the most serious pests. Similarly the causal organisms for blight and mildew (Fontem, 2004), and a range of viruses (Letts, 2009), misdirection of Federal funds, equipment and effort affect disease pressure. Aphids were the most recurrent insect pest on vegetable crops (Praveen and Dhandapani, 2002; Kekeunou et al., 2006). Most insect pests are vectors of disease organisms (Meyer, 2003). Viruses were identified by farmers among diseases on their crops in addition to blight and bacteria diseases. Their ability to identify and talk about insect pests and diseases, could indicate how economically important they are to farmers, since their identification knowledge is low.

Many farmers could identify factors that support pests and diseases. Landston and Eaker (2009) reported that rain, heavy dews, warm temperatures and dry climates (mostly for insects whose infestation is affected by rain) are principal conditions favouring pest establishment. Although cultural practices are recommended for pest management the practices were not accepted over chemical pesticides to increase production (Holmer et al., 2001). Although all farmers used chemical pesticides, as also indicated by Obopile et al. (2007), they did not have a good knowledge of pesticide handling. Most commonly used insecticides were dimethoate, deltamethrin and cypermethrine, and the most commonly used fungicides were maneb, metalaxyl, manizan and mancozeb (Matthews et al., 2003). Here, and in the work of Elizabeth and Zira (2009), it was reported that most vegetable farmers received extension information from neighbors and had little, or no, contact with government departments. They also reported that almost all respondents were aware of extension services, and an equal percentage recognized the usefulness of extension services. However, most were never visited by the extension service

which likely results in farmers' inability to identify pests and diseases of vegetables, poor pest management skills, and lack of good knowledge of the use of chemical pesticides.

Vegetable production is changing from women to men. Agriculture is considered a job for the underprivileged and school dropouts. Vegetable production is a year-round activity in the tropics. Pests and diseases are important constraints to vegetable production. Knowledge of crop diseases constitutes a major obstacle in vegetable production systems. To increase availability of vegetables their production needs to be intensified in urban areas, especially in developing countries (Hovorka, 2005). Vegetable breeding for resistance to major pests and diseases should consider consumer preference in addition to yield. Introduction of training programs for farmers on identification and management of pests, and on safe use of pesticides is necessary. This will improve farmer knowledge of diseases and insect pests of vegetables and improve management practices, especially with the high illiteracy level among farmers, and the aging farming population.

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Table 1: Percent of farmers who identified each crop as important by location.

Region	Site	Tomato	Hot pepper	Cabbage	Okra	Night-shade	Sweet pepper	Onion	Amaranth	Egg-plant	Jute mallow
Center	Bafia	100	60	88	71	79	67	33	0	67	71
	Obala	100	0	0	100	0	0	0	0	0	0
	Yaounde	94	0	50	0	100	92	0	100	67	0
	Bertoua	100	33	0	75	60	67	0	50	0	0
East	Abong-mbang	100	86	40	40	50	60	0	0	0	0

	Douala	20	43	33	67	86	0	0	0	0	0
Littoral	Njombe	33	89	100	67	100	0	0	0	0	0
Northwest	Santa	50	100	100	100	60	25	0	100	100	50
	Ndop	100	100	100	50	60	75	33	100	100	100
South	Ebolowa	91	40	33	36	30	50	0	20	33	0
	Amba m	83	50	0	0	100	33	0	0	0	0
	Buea	100	100	100	80	100	100	100	100	100	83
	Ekona	100	100	100	67	33	75	0	88	80	50
Southwest	Muyuka	33	40	88	57	100	33	0	0	71	33

	Dschang	43	12	73	29	55	0	94	50	0	20
	Bangante	100	100	0	67	67	100	100	100	100	0
West	Foumbot	100	88	67	92	89	82	100	73	100	0

Table 2: Farmer experience in market gardening.

District	Years in agriculture	Years in market gardening
Bertoua (East)	17.4	14.9
Buea (South west)	19.6	14.2
Douala (Littoral)	20	10
Ebolowa (South)	10.9	8.3
Ekona (South west)	11.8	7.8
Upper Nyong (East)	19.1	6.7
Lekie (Center)	18.0	11.8
Mbam Ekim (Center)	11.7	8.0
Menoua (West)	14.6	9.1

Mezam (North West)	23.3	22.8
Mfoundi (Center)	18.2	16.3
Moungo (Littoral)	15.3	21.6
Muyuka (South west)	15.9	14.0
Nde (West)	19.5	13.8
Ngoketunjia (North west)	27.9	16.3
Noun (West)	15.7	13.9
Ntem valley (Littoral)	9.0	5.7

Table 3. Percent of growers that identified specific pests as a constraint in the production of vegetable crops.

Pest type	Pest	Tomato	Hot pepper	Cabbage	Okra	Night-shade	Sweet pepper	Onion	Amaranth	Egg-plant	Jute mallow
Insect	Unknown	66.9	87.6	92.2	89.2	86	93.7	99	93.8	98.8	98.3
	Ants	1.3	0.9		1.3	3.2			4		1
	Aphids	4	2.7	3	2.5	4.5	1.7		1	0.5	1
	Beetles				2.8	2	0.5		4.5		0.5
	Caterpillars	18.5	6.1	4.8	2.9	3.3	1.8	0.5	2	0.8	0.5
	Cricket	3 .5			2		0.8	0.5	1.7	1	0.5
	White	9.3	2.7				2.9		1.8	0.8	

	fly										
Disease	Unknown	70.7	93	97.9	9.6	95.2				99.5	99.5
	Blight	14.5	3.8	4	1.8	5.4	1.3	0.5	2	0.5	1
	Viruses	0.8	2		1.5	3	0.5				
	Bacteria Wilt	4.2	1		1.5	0.7					0.5

Table 4: Sources of pest and disease identified by vegetable farmers.

Source	Percent
None	44.4
Climate change	8.6
Manure	0.5
Humidity	15.3
No treatment	7.5
Poor seed	2.0
Soil borne	12.1
Surrounding vegetation	7.1

Variety	1
Wind	1.5

Table 5: Percentage of farmers who used methods other than chemical control (pesticides) for pest management.

Alternative pest management	Percent
Do not know	74.8
Use resistant varieties	0.5
Farming systems	6
Engine oil	0.5
IPM	0.5
Tobacco solution	4.5
Wood ash	10.2

Tables 6. Source of vegetable pest management information in Cameroon.

Source of information	Yes (%)	No (%)
From other farmers	73.1	26.9
From agro-dealers	20	80
From radio	5	95
From newspapers	10	90
From seed companies	16	84
From extension agents	38	62
From TV	7.1	92.9
Other	11.7	88.3

Figure 1. Age groups and levels of education of vegetable farmers.

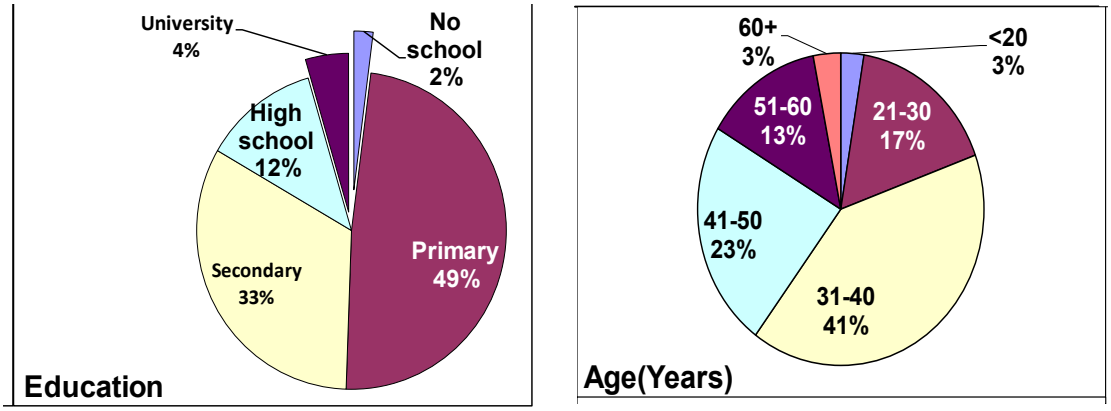

Figure 2: Comparison between farmers who consider each crop as very important and total percent of farmers who grow each crop.

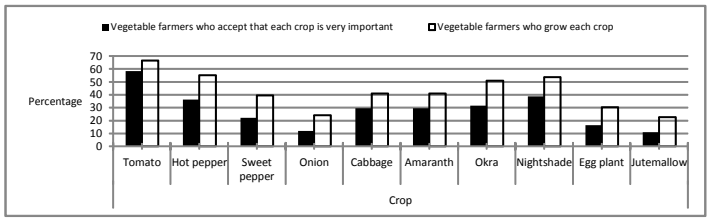

Figure 3: Farm size distribution used for vegetable production.

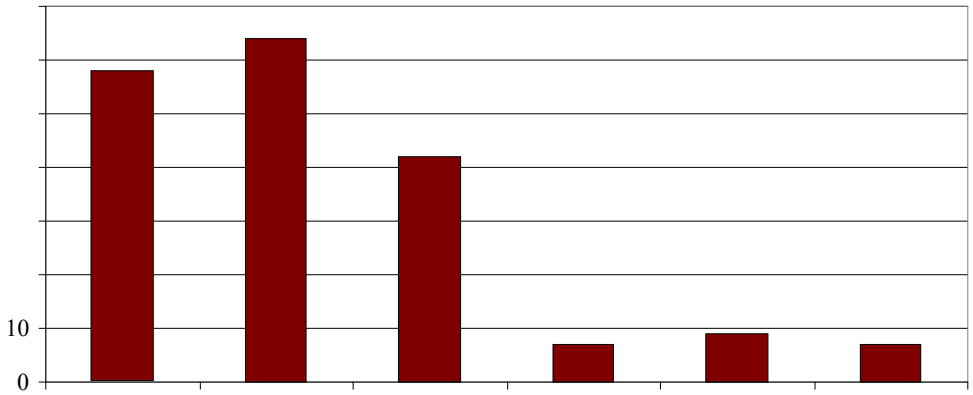

Figure 4: Acceptable traits of susceptible vegetable varieties, Precocity is early maturity of the crop

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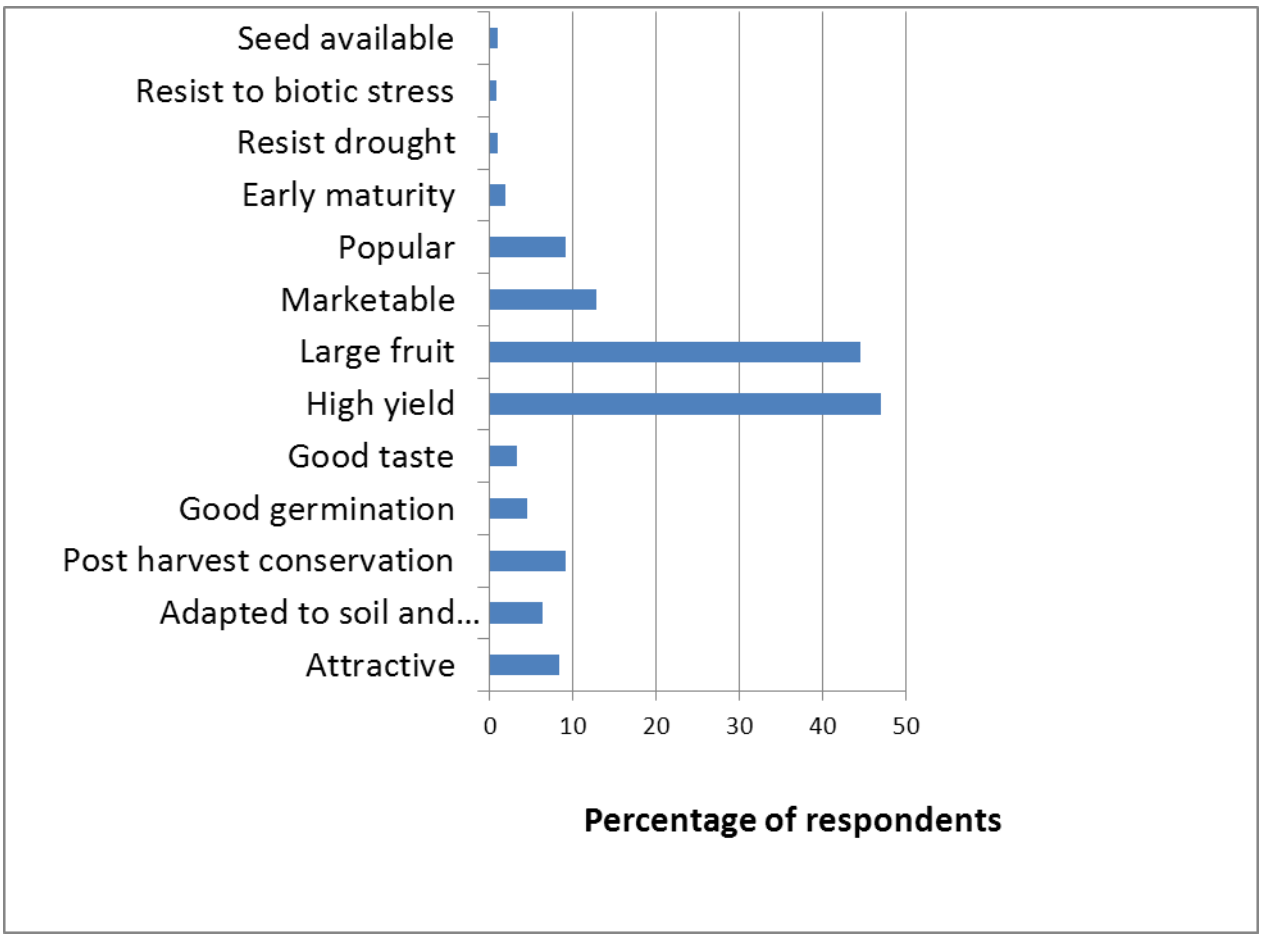
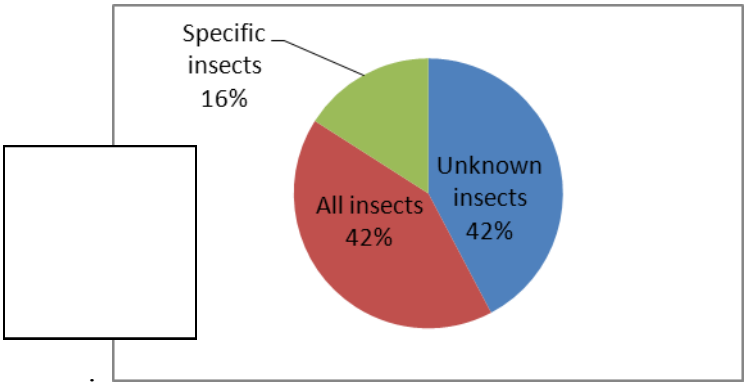


Figure 5. Farmer knowledge of control of pest a) insects, b) diseases.



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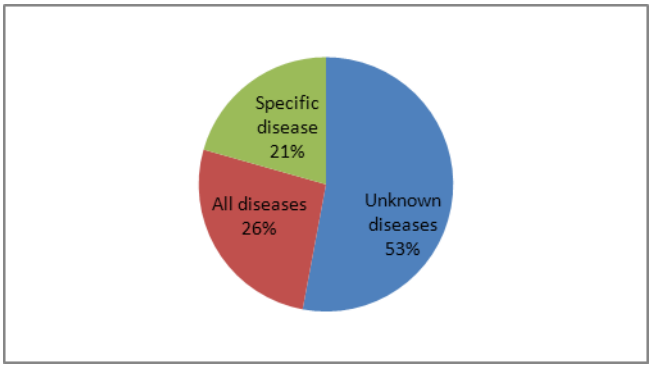
a. Insect pests



b. Diseases