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QUARANTINE AND OTHER IMPORTANT DISEASES AFFECTING ECONOMIC CROPS IN THE CORDILLERA

Janet S. Luis, Jocelyn C. Perez, Grace S. Backian, Jennie T. Bawayan, Cynthia G. Kiswa and Clarence B. Codod

College of Agriculture, Benguet State University

ABSTRACT

The Cordillera Administrative Region provides the ideal environment for the production of planting materials of semi-temperate vegetables, root crops, beverages, fruits and ornamentals. However, the presence of degenerative diseases caused by viruses do not only reduce yield in time but also affects the planting materials produced. Under the quarantine regulations, the movement of planting material from country of origin to the destination country primarily requires the indexing of plant viruses before they are transported and planted in the field. Hence, a survey was conducted in Abra, Apayao, Benguet, Ifugao, Kalinga and Mountain Province to identify and assess the incidence and severity of diseases of quarantine importance affecting high value crops.

For virus diseases, 100% incidence of Tomato Mosaic Virus (TMV) was recorded in one hectare tomato farm in Bokod, Benguet; Banana Bunchy Top Virus (BBTV) with 40% incidence at Sablan, Benguet (0.20 ha); 20% in Balbalan, Kalinga (0.03 ha), 30% at Conner, Apayao (2.5 ha) and 20% in Aguinaldo, Ifugao (1.5 ha); Turnip Yellow Mosaic Virus (TYMV) in 80% of Chinese cabbage plants (0.20 ha) at Buguias, Benguet;15% incidence of Potato Aucuba Mosaic Virus (PAMV) in potato at Bauko, Mountain Province (0.25 ha); and 12% incidence of yellowing, little leaf and mosaic symptoms in coffee seedlings in nurseries in Tublay, Benguet.

For bacterial diseases, 10% incidence of mushroom bacterial blotch (*Pseudomonas sp.*) was noted in La Trinidad and *Ralstonia solanacearum* Race 1 causing bacterial wilt was isolated from seed potatoes collected in Atok, Benguet. Rose crown gall was known to be a serious problem in white rose in Alno, La Trinidad, Benguet.

Fungal diseases documented were yam anthracnose, chrysanthemum white rust, anthurium leaf spot, strawberry leaf spot and berry rot, coffee leaf spot and *Fusarium* wilt in banana while those due by fungal-like organisms were potato late blight and taro leaf blight.

Key words: *quarantine diseases, semi-temperate vegetables and high value crops*

INTRODUCTION

The Cordillera, specifically Benguet and Mountain Province is known as the major producer of semi-temperate vegetables, ornamentals and fruits. Ifugao, Apayao, Kalinga and Abra together with Benguet and Mountain Province are main sources of coffee (Arabica and Robusta) and root crops. In any crop production venture, the availability of good seeds/planting materials guarantees a bountiful harvest. However, because of the exchange and use of infected planting materials, crop management practices of farmers, changing climate and the lack of indexing/certification of seed materials and crops, the occurrence of diseases both in the soil and seed/planting materials continuously increase.

At present, Benguet State University (BSU) supplies farmer-cooperators with limited volumes of perceived disease-free in-vitro plantlets of strawberry, potato, sweet potato, chrysanthemum, colored callas, chayote, banana and seeds of snap

beans, garden pea, French beans and pechay. However, these cannot be considered certified seeds/planting materials because no indexing is done against diseases caused by viruses, fungi, bacteria and mycoplasma-like organisms. Uncertified planting materials can still be harboring diseases especially those of quarantine or regulatory importance. Only potato and sweet potato planting materials produced at the Northern Philippines Root Crops Research and Training Center, BSU, La Trinidad, Benguet are indexed for viruses through the Enzyme-Linked Immunosorbent Assay (ELISA), a serological technique performed for the detection of viruses.

In potato seed production, since planting materials commonly used is vegetative, viruses and viroids are particularly important. Under the quarantine regulations, the movement of planting materials from the country of origin to the destination requires virus indexing in plants before they are transported and planted in the field. Virus infected seeds may cause loss in potential yield. It has been estimated that about 30-80% in yields are lost due to Potato Virus Y (PVY) in susceptible varieties. Potato Virus Y is also responsible for the running out or degeneration of seeds. Among the most prevalent virus diseases existing in most seed growing areas are Potato leaf roll virus (PLRV), Potato virus S (PVS), Potato virus Y (PVY) and Potato Virus X (PVX). In addition, several strains of viroids can also cause losses of up to 65%. Common potato viruses however, do not show any symptoms in tubers, thus, escaping negative selection resulting in a crop infected with viruses (Struik and Wiersema, 1999).

In sweet potato, it was reported that at least 20 viruses are known to infect the crop individually or in mixed infection. Sweet potato is also attacked by a number of important diseases causing yield losses to as high as 50% and in some cases total yield loss (Gapasin , 1987 as cited by Perez *et al*., 2001). In Central Luzon, particularly Tarlac and Bataan which produces the highest tonnage of sweetpotato for commercial uses, the "camote-kulot" disease of sweet potato is due to a mixture of two or more viruses infecting sweetpotato simultaneously such as SPFMV with other viruses like SPMMV, C-6, SPMSV, SPCalV and PPCSV, (Vasquez *et al*., 2012).

The National Seed Industry Council (NSIC) under the Seed Industry Development act of 1992 has set general guidelines to be followed to ensure reasonable standard of quality of planting materials of root crops, sugarcane, ornamentals, fruit and plantation crops for propagation and distribution. The sustainability of agricultural activity, depends to a great extent on preventing the introduction of exotic plagues which could have a high economic impact. Thus, in the impending ASEAN Free Trade in 2015, diseases affecting our crops must be properly identified in order to prevent the entry of new diseases from other countries.

Objectives

1.The study aimed to: survey, collect and identify major quarantine diseases (viruses and bacteria) of 20 identified economic crops in CAR; and

2.assess and identify other diseases caused by fungi which are important for future Pest Risk Analysis (PRA) activities.

MATERIALS AND METHODS

Survey and characterization of virus and bacterial diseases of target crops

Diseased plants/seeds/planting materials showing symptoms of 27 target virus diseases and two bacterial diseases of quarantine concern in 20 target crops were collected from CAR (Table 1). Collection was done in individual bags labeled with the suspected name of the disease, date and place of collection and name of farmer. Description of the symptoms and all other observations were documented. Pictures were taken for proper documentation. Potato tuber samples were indexed using Double Antibody Sandwich-Enzyme Linked Immunosorbent Assay (DAS-ELISA). Disease incidence was taken based on the proportion of the diseased plants within an area while disease severity was based on the proportion of the plant area that was affected.

Table 1. Viruses, viroid and bacterial diseases of concern in the production of certified seeds and/or planting materials of the target crops

Crop	Viral Disease	Bacterial Disease
1. Strawberry	Strawberry Crinckle Virus (SCV)	
2. Mushroom		Bacterial Blotch
3. Potato	Potato Virus X (PVX), Potato Virus Y (PVY), Potato Spindle Tuber Viroid (PLRV)	Bacterial Wilt
4. Sweet Potato	Sweet Potato Feathery Mottle Virus (SPFMV)	
5. Yam	Yam Mosaic Virus (YMV)	
6. Taro	Taro Mosaiv Virus (TaMV)	
7. Beans	Bean Yellow Mosaic Virus (BYMV) Bean Common Mosaic Virus (BCMV)	
8. Garden Pea	Garden Pea Seed Borne Mosaic Virus (PSMV), Pea Enation Virus (PEV)	
9. Cabbage/Broccoli	Cabbage Ring Spot Virus (CRSV)	
10. Chinese Cabbage	Cabbage Mosaic Virus (CabMV) Cabbage Ring Spot Virus (CRSV)	
11. Cucumber	Cucumber Mosaic Virus (CuMV)	
12. Carrot	Carrot Thin Leaf Virus (CTLV) Carrot Mosaic Virus (CaMV)	
13. Tomato	Tomato Mosaic Virus (TMV) Tomato Rattle Virus (TRV)	
14. Coffee	Coffee Ring Spot Virus (CRSV)	
15. Chrysanthemum	Chrysanthemum Mosaic Virus (CMV)	
16. Rose	Rose Mosaic Virus (RMV)	
17.Lilium	Lilium Mosaic Virus (LMV)	
18. Anthurium	Anthurium Mosaic Virus (AMV)	
19. Banana	Banana Bunchy Top Virus (BBTV)	
20. Ginger	Ginger Mosaic Virus (GMV)	

Characterization of diseases of quarantine importance

Isolation of bacterial diseases

Potato plants showing symptoms of bacterial wilt and mushrooms exhibiting bacterial blotch symptoms were collected. Diseased tissues were sliced and soaked in water blanks for 15 minutes to induce oozing of bacteria. The flame-sterilized wire loop was dipped in the bacterial suspension and was streaked in plated nutrient agar media. The cultures were incubated at 28 °C for 48 hours.

Pathogenicity test of collected and identified bacterial disease

10 ml bacterial suspension from pure cultures of *R. solanacearum* was injected through the nodes of 30-day old tomatoes (*Lycopersicum sp*. Rutgers).

Identification and characterization of potato viruses

Potato tubers which were tested positive of Potato Viruses X, Y and S using DAS-ELISA were mechanically transmitted to *Nicotiana tabacum, Chenopodium amaranticolor, Solanum nigrum, Physalis floridana* and potato stem cuttings of the Igorota variety of potato. These indicator plants were subjected under dark conditions for five days and symptoms were observed 14 days later.

RESULTS AND DISCUSSION

Survey and characterization of virus and bacterial diseases of target crops

Diseases caused by viruses and bacteria among the 20 crops surveyed is summarized in Table 1. Except for mushroom, all the other crops had virus diseases with mosaic virus as the most common.

A total estimated area of 33.35 ha farm was surveyed in CAR; 12.1 ha in the 13 municipalities of Benguet, 6.6 ha in Apayao, 3.67 ha in Mountain Province, 2.3 ha in Ifugao, 8.10 ha in Abra and 0.58 ha in Kalinga (Table 2, Fig. 1).

Results of survey showed a 100% incidence of TMV-damaged tomato farms summing up to one ha in Bila, Bokod, Benguet. Infected tomato plants exhibited mosaic, crinkling and leathery leaves and small and harder fruits. Another serious problem is the suspected virus infection of Chinese cabbage plants that caused 80% damage on Chinese cabbage farms in Loo, Buguias, Benguet (Table 2). The farmers claim that the disease first appeared in 2013 where leaves of the plants turned pale yellow with alternate green and yellow color and the non-formation of heads which were classified as unmarketable. The farmers suspected that the disease is seed-borne and was first observed at Sitio Posong, Loo, Buguias which had 100% damage on the commonly planted Chinese cabbage cultivar PR 95 and Alabama. Most vegetable seeds (cabbage, Chinese cabbage, cucumber, broccoli and carrots) are imported and are available in the local market. Other areas affected by the virus are Lam-ayan, Bugiuas and Balili, Mankayan. Infected plants were also documented in Atok exhibiting the same symptoms (Nagpala *et al.*, 2014). Based on the symptoms, the disease is caused by the Turnip Yellow Mosaic Virus (TYMV) which was reported by Smith (2008). The disease is seed-borne as there were no vectors observed during the survey. Prevalence of Cabbage Ring Spot Virus (CRSV) was nil during the survey.

Figure 1. Areas surveyed in CAR for the incidence of quarantine diseases

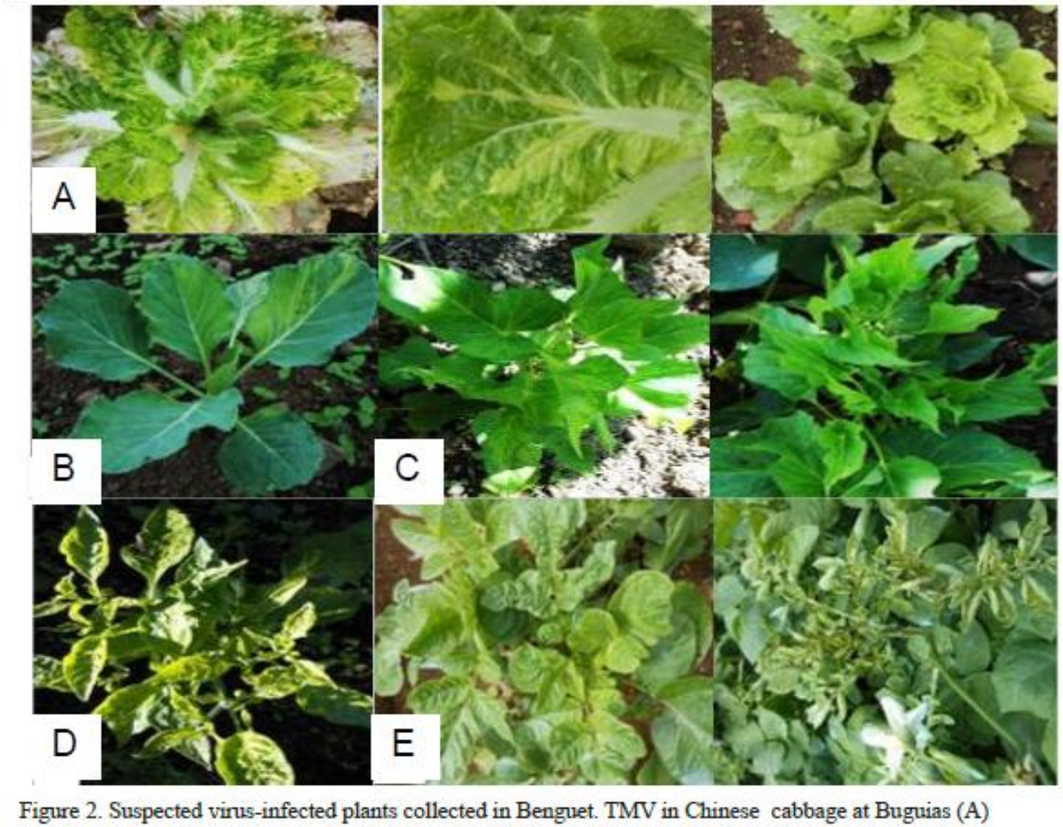

Figure 2. Suspected virus-infected plants collected in Benguet. TMV in Chinese cabbage at Buguias (A) and cabbage in Mankayan (B), Sweet potato Feathery Mottle Virus (C), Pepper Mosaic Virus in Bakun (D) and Potato Aucuba Mosaic Virus (E) in Mankayan

In Apayao, the Banana Bunchy Top Virus (BBTV) is widespread with 25-30% incidence. The farmers observed that cv. Lakatan, the most cultivated variety in the locality is the most susceptible to the virus. Consequently, farmers plant the more tolerant banana varieties such as Gloria, Saba, Dippig and Señorita. The farmers attributed the tissue-cultured planting materials distributed by the local government unit as the source of infection.

Symptoms of virus infection were also observed in sweet potato as Sweet potato Feathery Virus and Sweet potato Leaf Thinning and in taro as Taro Feathery Virus (Table 2). The virus affecting the sweet potato production in Central Luzon provinces of Tarlac and Bataan, is the camote *kulot* which is caused by a virus complex or a combination of 2 or more viruses (Upali and Laranang, 1999 as cited by Laranang and Basilio, 2002).

The elevated parts of Kalinga particularly Lubuagan were documented to be suitable for the production of semi-temperate vegetables like cabbage, Chinese cabbage, carrot, bell pepper, beans and garden pea. It is, however in this area where virus symptoms were seen in cabbage. Infected plants exhibited alternate green and yellow color on the leaves. About 1% incidence was documented.

In sweet potato, plants showing malformation, thinning and mottling of the leaves were observed (Table 2). Inspite of Kalinga's potential as a source of semi-temperate vegetables and root crops, majority of its produce is for home consumption as these areas are inaccessible and far from the market. Farmers who grow vegetables in wider areas barter their produce for rice.

Similar crops are grown in Mountain Province and Benguet farms. In the greenhouse-grown

Table 2. Incidence of suspected viral diseases of crops with economic importance in CAR

Location	Total Estimated Area (ha)	Crop	Suspected Viral Disease	Incidence
Benguet	12.1	Anthurium	Anthurium Mosaic Virus	20
		Rose	Rose Mosaic Virus	.01
		Potato	Potato Viruses X, Y, S, Leaf Roll	3-9
		Sweet potato	Sweet potato Feathery Mottle Virus	20
		Taro	Taro Feathery Mottle Virus	1-20
		Yam	Yam Mosaic Virus	5
		Cabbage/Chinese Cabbage	Turnip Yellow Mosaic Virus	80
		Pepper	Cucumber Mosaic Virus	5-14
		Coffee	Coffee Little Leaf Virus, Mosaic	5
		Banana	Banana Bunchy Top Virus	40
		Strawberry	Strawberry Crinkle Virus	12
		Tomato	Tomato Mosaic Virus	100
Apayao	6.6	Banana	Banana Bunchy Top Virus	25-30
		Sweetpotato	Sweet potato Feathery Mottle Virus	5-20
		Taro	Taro Feathery Virus	10-15
Mountain Province	3.67	Potato	Potato Aucuba Mosaic Virus	5-10
			Potato Viruses X, Y, S, Leaf Roll	6
		Beans	Leaf Enation, Mosaic, Greening	17
		Cabbage	Vein Clearing Virus	2.5
		Pepper	Pepper Vein Clearing Virus	52
Ifugao	2.3	Banana	Banana Bunchy Top Virus	
Abra	8.10	Banana	Banana Bunchy Top Virus	2
		Coffee	Coffee Little Leaf Virus	5
Kalinga	0.58	Banana	Banana Bunchy Top Virus	20
		Taro	Taro Feathery Virus	3
		Cabbage	Turnip Yellow Mosaic Virus	10

strawberry, 15% of the plants exhibited mosaic, crinkled leaves and deformed fruits akin to virus infection (Table 2). The symptoms observed are unlikely caused by nutrient deficiency because fertilizer requirements were with the irrigation system.

In garden pea, rosetting and enation (small outgrowth on the leaf caused by virus) was observed. About 15% of the plants showed multiple leaf formation that appears like a rose and 10% showed reduction in leaf size.

There was a higher virus infection incidence in pepper planted in Sabangan compared to those planted in Bauko. Assessment showed 52% incidence of vein-clearing, 27% incidence of leaf enation and 17.9% incidence of both vein-clearing and leaf venation. Virus diseases are transmitted through seeds, hence, farmers who keep seeds from a table crop experience incidence of virus infection. In addition, spread of these viruses is enhanced by obtaining seeds from other farmers without certification or any positive/negative selection for seed purposes.

In Ifugao, the municipalities of Asipulo, Kiangan and Aguinaldo were surveyed for diseases of quarantine importance (Table 3). In Kiangan, a disease was observed in sweet potato that caused

wilting starting from the stem base resulting in death of the plant. Laboratory diagnosis revealed that the infection was caused by *Fusarium sp*. Only a small area planted with sweet potato in Asipulo was documented since the farmers were still preparing the area for planting during the survey.

Banana Bunchy Top Virus was very evident in three sitios of Aguinaldo, Ifugao (Ubao, Chalalo and Posnaan) where banana plantations are found. An area of 1.5 ha in Ubao was burned because of 100% BBTV infection. Shoots were observed to be developing (after 2 weeks) from the suckers even if the plants were burned. The disease was observed during the rainy season. 20% disease incidence was observed in Posnaan and Chalalo (Table 2).

In Abra, 2% incidence of BBTV was documented. The farmers also observed that Cv. Lakatan is susceptible to BBTV. The suspected Little Leaf Virus in coffee was also observed in the area. One coffee tree showed reduced leaf than the normal size, with small berries. Coffee varieties planted in the area were Robusta, Arabica and Liberica (Table 2). Identification and characterization of plant viruses

Potato Viruses

Necrotic spots were both observed on leaf margins of *N. tabacum* and *C. amaranticolor* while vein clearing was observed only in *N. tabacum*. These results corroborate with the findings of the International Potato Center (CIP) for Potato Viruses X, Y and S as to local and systemic symptoms in indicator plants. The results also confirms the complex occurrence of viruses in potato.

Sweet potato Viruses

Aphid transmission of Sweet potato Feathery Mottle Virus (SPFMV) in a non-persistent manner done on *I. setosa* resulted in vein-clearing, leaf yellowing and leaf thinning 19 days after incubation. This potyvirus is likely transmitted by insects (Fig. 3).

Turnip Yellow Mosaic Virus on Chinese cabbage

The new disease of Chinese cabbage which infected plants in Buguias and some parts of Mankayan and Atok was determined to be caused by a virus. The results of the sap transmission in the laboratory showed identical symptoms on Chinese cabbage plants documented in the field. Infection starts with single chlorotic spots on leaves which later coalesce forming the mosaic appearance. This virus is very stable and appears in large concentration in sap (Gibbs and Harrison, 1976). Sap transmission in *S. nigrum* exhibited leaf deformation and leaf thinning, necrotic spots and vein-clearing in *P. floridana*, mosaic in *P. vulgaris*, leaf deformation and vein banding in rice bean and leaf mottling in cucumber. Symptoms uniformly appeared 14 days after inoculation (DAI) in *S. nigrum, P. floridana* and *V. unguiculata* rice bean (Fig. 4).

Other Important Diseases

Diagnosis and documentation of other diseases of quarantine importance

Aside from virus infection, bacteria and fungi causing economic damage on potato, sweet potato, taro, yam, ginger, rose, chrysanthemum, anthurium, strawberry, mushroom, pepper, beans, cabbage, Chinese cabbage, cucumber, tomato, banana and coffee were collected and documented (Table 3).

Fungal diseases of potato caused by *Phytophthora infestans* was prevalent in Benguet and Mountain Province. Leaf spot of sweet potato caused by *Cercospora sp*. and *Phomopsis sp*. were the common diseases in sweet potato growing areas in Benguet, Mountain Province and Ifugao. There is an emerging disease in sweet potato which is the leaf and stem rot caused by *Fusarium sp*.

Other diseases documented are leaf spot in cabbage, pepper, tomato, rose and coffee; white rust in chrysanthemum and fruit rot in pepper. Berry rot in strawberry is common in Benguet and Mountain Province where strawberry is grown commercially.

Table 3. Fungal and bacterial diseases of target crops in surveyed areas of Benguet, Apayao, Kalinga, Mountain Province, Ifugao and Abra

Location	Crop	Disease	Pathogen
Benguet	Potato	Late blight	*Phytophthora infestans*
	Sweet Potato	Leaf spot	*Phomopsis sp*
		Leaf spot	*Cercospora sp.*
	Taro	Taro blight	*Phytophthora sp.*
	Yam	Leaf spot	*Cercospora sp.*
	Ginger	Leaf spot	*Phyllosticta sp.*
		Leaf spot	*Alternaria sp*
	Rose	Leaf spot	*Marssonina sp.*
		Crown gall	*Agrobacterium tumefaciens*
	Chrysanthemum	White rust	*Puccinia horiana*
	Anthurium	Bacterial Leaf spot/Blight	*Xanthomonas sp.*
		Leaf spot	*Cercospora sp.,Pestalotia sp.*
	Strawberry	Berry dry rot	*Phytophthora sp.*
		Berry rot	*Colletotrichum sp.*
	Pepper	Fruit rot	*Fusarium sp.*
		Leaf spot	*Alternaria sp.,Cercospora sp.*
	Beans	Pod spots	*Colletotrichum sp.*
		Bean rust	*Uromyces phaseoli*
	Cabbage	Leaf spot	*Alternaria sp.*
	Chinese Cabbage	Leaf spot	*Alternaria sp.*
	Tomato	Leaf spot	*Phytophthora sp.,Cercospora sp.*
	Coffee	Leaf spot/berry	*Cercospora sp.*
		Leaf spot/berry rot	*Colletotrichum sp.*
		Coffee rust	*Hemileia vastatrix*
Apayao	Taro	Leaf spot	*Phytophthora sp.*
Kalinga	Taro	Leaf blight	*Phytophthora colocasiae*
	Cabbage	Soft rot	*Xanthomonas campestris*
	Ginger	Leaf spot	*Phylosticta sp*
	Beans	Bean anthracnose	*Colletotrichum sp.*
Mountain Province	Strawberry	Berry rot	*Phytophthora fragariae*
		Fruit rot	*Colletotrichum fragariae*
		Fruit rot	*Botrytis cineria*
	Potato	Late blight	*Phytophthora infestans*
		Common scab	*Streptomyces sp.*
	Cabbage	Leaf spot	*Cercospora brassicola*
			Alternaria sp
	Coffee	Coffee rust	*Hemileia vastatrix*
		Leaf spot	*Cercospora sp.*
	Sweet potato	Leaf spot	*Phomopsis sp.*
Ifugao	Sweet potato	Leaf and stem rot	*Fusarium sp*
	Banana	Banana Leaf spot	*Mycosphaerella sp.*
	Coffee	Algal leaf spot	*Cercospora sp.*
Abra	Banana	Panama wilt	*Fusarium sp.*
	Coffee	Leaf spot	*Cercospora sp.*

Figure 3. Symptom of SPFMV in *I. setosa* after transmission by *Myzus persicae* (B); healthy vine (A)

Figure 4. Symptoms shown by indicator plants after mechanical transmission by TYMV in Chinese cabbage

Bacterial diseases

Bacteria isolated from oyster mushroom exhibiting blotch had cream color, beaded growth, irregular and spreading configuration, lobate margin and umbonate elevation when grown in nutrient agar. Gram staining and microscopy revealed that bacterial cells are Gram negative and rod shaped. The isolate was initially identified as *Pseudomonas fluorescens*.

A pure culture of bacterial wilt affecting solanaceous crops caused by *R. solanacearum* was obtained from infected potato tuber. A selective medium, Tetrazolium Chloride Agar (TZCA), was used to isolate the pathogen. Previous studies reveal that the race affecting the potato growing areas of Benguet and Mountain Province is Race 1 (Fig. 5).

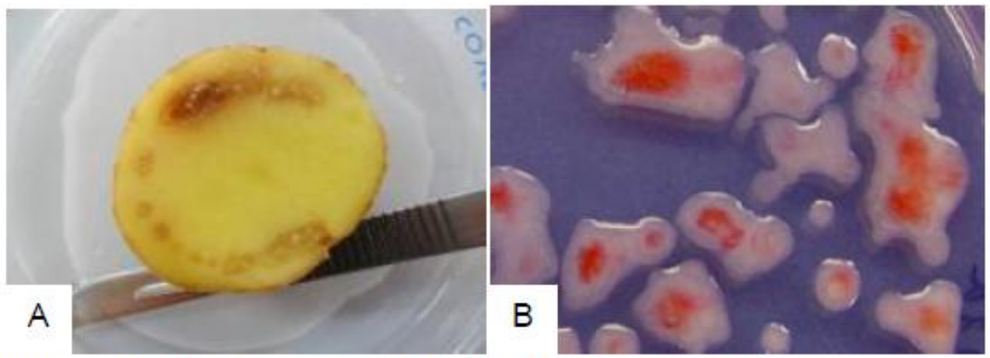

Figure 5. Potato tuber infected by bacterial wilt (A) and *R. solanacearum* in TZCA (B)

Pathogenicity tests of quarantine diseases

The nodes of tomato plants were injected with 10 ml bacterial suspension of *R. solanacearum*. After five days, two leaves wilted and after four more days, the whole tomato plant wilted. Wilting was not observed on the control. The development of wilting symptoms was manifested from 26 days after inoculation (Fig. 6).

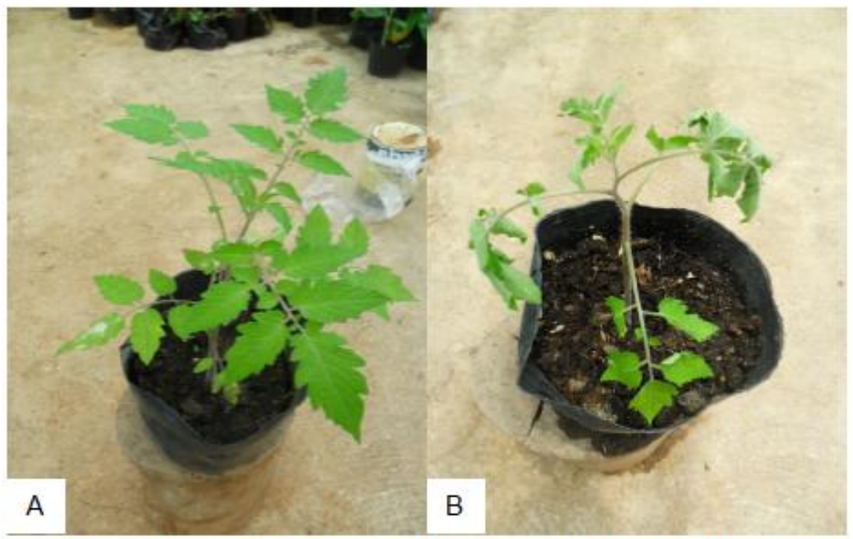

Figure 6. Tomato seedling (A) un-inoculated and (B) inoculated with *R. solanacearum*

Other important bacterial disease

Crown gall of rose caused by *Agrobacterium tumefaciens* is becoming a serious problem of the rose industry in Benguet specifically in Alno, La Trinidad. The disease was documented to be more serious in the white rose variety. Pathogenicity test using tomato was done where bacterial ooze from crown galls were injected into the nodes of the assay plants. Small gall-like growth (approx. 3-5mm diameter) were observed on tomato plants 26 days after inoculation (Fig. 7).

Figure 7. Tomato seedling inoculated with *Agrobacterium* from white rose variety

CONCLUSIONS AND RECOMMENDATIONS

Virus diseases are prevalent across the six provinces of CAR and across all target crops. Among the virus diseases affecting semi-temperate vegetables are Turnip Yellow Mosaic Virus (TYMV) in Chinese cabbage, Cabbage Mosaic Virus (CabMV) in cabbage, Tomato Mosaic Virus (TMV) in tomato, Cucumber Mosaic Virus (CMV) in pepper, Potato Viruses X, Y, S, Aucuba Mosaic and leaf roll in potato, leaf enation and Bean Mosaic Virus (BMV) in beans and garden pea. For root crops: Sweet potato Feathery Mottle Virus (SPFMV) in sweet potato, Taro Feathery Mottle Virus (TFMV) in taro and Yam Mosaic Virus (YMV) in yam. For fruits: Banana Bunchy Top Virus (BBTV) in banana and Strawberry Crinkle Virus (SCV) in strawberry.

Common symptoms of virus infection on target crops (semi-temperate vegetables -cabbage, Chinese cabbage, carrots, beans, cucumber, garden pea, potato and tomato; Root crops- sweet potato, taro and yam; Fruits – strawberry and banana; Ornamentals–chrysanthemum, lilium, anthurium and rose and Coffee) include dwarfing or stunting, mosaic, mottling, streak, vein clearing, vein banding, ringspot, enation (small outgrowth on the leaf caused by virus infection) distortion or malformation of leaves and fruits, abnormal greening, crinkling and necrotic spots on the leaves and fruits.

The areas surveyed are limited because at the time of the assessment, only a small portion is planted with the target crops. With the presence of diseases of quarantine importance, seed certification of the economic crops should be in place. In certifying seeds and/or planting materials of the target crops in the Cordillera, the source of antisera is a problem. Local antisera production is therefore recommended for the production of virus-free planting materials.

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