SELECTED ECONOMICALLY IMPORTANT DISEASES OF SOME MAJOR CROPS IN THE PHILIPPINES

Tiburcio T. Reyes*

ABSTRACT

Losses due to rice tungro, coconut cadang-cadang and lethal wilt, sugarcane smut and abaca mosaic and their management were discussed.

Outbreaks of tungro in the 1940s caused an estimated loss of 1.4 million tons of rough rice annually and in the 1971 wet season, 61,000 tons of rough rice valued at US$2.2 million. Losses due to cadang-cadang were US$1.8, US$11, US$25, US$3.5 and US$2.1 million in 1950, 1953, 1957, 1980 and 1987, respectively. Although losses are decreasing, rate of disease increase is still 0.26 — 1.32%/yr. The average number of lethal wilt infected and cut down palms in Oriental Mindoro in the last 6 years was 1,600 or a loss of 14.3 tons of copra valued at US$5,107. The number of palms killed in 1977 and 1979 was 1,524 and 2,655, respectively. The national average loss due to sugarcane smut is 10% which is equivalent to about 1.5 million tons of cane or 148,082 tons of sugar. Mosaic caused the downfall of the abaca industry in Mindanao. Of the 49,000 ha of abaca land in the Bicol region in 1987, 4,600 ha were mosaic-affected. The total number of mosaic-infected plants rogued and estimated yield loss were 3.5 million and 925 tons of fiber, respectively. Disease incidence of 80% resulted in 60% fiber yield loss/mo.

Management of these diseases includes the use of resistant or tolerant varieties, use of certified disease-free seeds, eradication of diseased plants, clean culture, and spraying with insecticides against the insect vector(s).

Introduction

The Philippines has a climate that permits profitable growing of food and commercial crops throughout the year. However, this climate is also conducive to the development of diseases.

This paper deals with selected economically important diseases of rice (*Oryza sativa* L.), coconut (*Cocos nucifera* L.), sugarcane (*Saccharum officinarum* L.) and abaca (*Musa textilis* Nee), losses occasioned by their outbreaks, and management.

Rice

1 Tungro disease

Tungro is probably the most important virus disease of rice in the Philippines (Fig. 1). It is caused by the rice tungro bacilliform virus and rice tungro spherical virus transmitted mainly by the leafhopper *Nephotettix virescens* (Distant) in a semi-persistent manner.

1) Outbreaks and losses

Tungro broke out in 1941, in 1957, and in 1968-1970 (Olivares *et al.*, 1980). The outbreak of tungro in the 1940s caused 30% yield loss equivalent to 1.4 million tons of rough rice annually. In the wet season cropping of 1971, about 70,000 ha of the 3.2 million ha planted to rice were affected by tungro at varying degrees of severity causing yield reduction of 1.22 million cavans of rough rice (61,000 tons) valued at US$2.2 million. When the disease first appeared in Western Visayas (Region 6), it affected only 65 ha (Anon., 1978). The area affected increased to 581 ha in 1973 and declined during the next 2 years to 22 ha. It reached another peak in 1977 affecting 1,428 ha. The disease was not reported in 1978 but reappeared in 1982.

* Associate Professor, Department of Plant Pathology, College of Agriculture, University of the Philippines at Los Banos, College, Laguna, Philippines.

Fig. 1 Rice plants on the left are healthy, on the right they are tungro—infected. Note the stunting and yellowing of the diseased plants.

Table 1 Areas affected by tungro disease in the Provinces of Region 6 and degree of infection, 1982-1984

Province	Area affected (Ha)			Infection degree
	1982	1983	1984	
Aklan	0	0	118	Severe
Antique	1,118	0	456	Severe
Capiz	200	30	8	Moderate
Iloilo	81	204	365	Severe
Negros Occidental	0	0	10	Moderate

Source: M.P. Bayoneta and F.J. Pinuela, 1984.

Incidence of rice tungro in Region 6 was monitored from 1982 to 1984 and was found in all the provinces except in Guimaras (Table 1). In 1982 and 1983, the disease was absent in Aklan and Negros Occidental. The total tungro-affected area in 1982 which was 1,399 ha, decreased in 1983 to 234 ha and increased again in 1984 to 956 ha. The rice varieties grown were IR 36, 42, 44, 46, 50, BE-3 and UPL Ri-5. Increase in the affected area in 1982 and 1984 was due to the breakdown of resistance of IR 36, the major variety, to the disease coupled with the high population of green leafhoppers, the vector. The variety IR 36 was replaced with IR 54, but IR 54 was replaced later with IR 60 because it is susceptible to blast (*Pyricularia oryzae* Cav.). Because of its long dormancy period and low germination, IR 60 was again replaced with IR 36, hence the outbreak in 1984.

Lately, tungro has been occurring sporadically. In 1987, it occurred only in five of 12 regions of the country. The total area affected in the five regions was 11,164 ha or 0.34% of the 3.22 million ha planted to rice that year. The varieties planted in the areas were moderately to highly susceptible to tungro. The disease was not observed in Bulacan, Nueva Ecija and Pampanga where it was first observed in the 1940s.

2) Management

Limited success in managing tungro is attributed to the continuous use of susceptible but high-yielding varieties, cropping throughout the year in some areas, presence of grass weed hosts of the virus and its vectors in rice areas, abundance of viruliferous insect vectors in the field and presence of infected stubbles which serve as virus source.

The most effective control of tungro disease is the use of varieties resistant or tolerant to the virus and the vectors. Spraying with insecticides against the vectors will also prevent the spread of the disease.

Coconut palm

1 Cadang-cadang

Cadang-cadang, caused by a viroid-like pathogen, is the most destructive disease of the coconut palm (Fig. 2). From San Miguel island where it was first observed it spread to Albay, Camarines Sur, Camarines Norte, Quezon, Catanduanes, Masbate, three Samar provinces and Leyte (Bigornia *et al.*, 1980).

1) Outbreaks and losses

The disease was estimated to have caused a loss of US$1.8 million in copra alone in 1950 (Kent, 1953). The estimated number of coconut trees destroyed by the disease in 1951, 1952, and 1953 was 1.8, 4.6, and 5.5 million, respectively. The loss occasioned by the destroyed trees in 1953 alone was estimated at US$11 million with an export value of US$175 million.

In 1957, the average number of diseased trees in the Bicol region was 8 million, causing an estimated yield loss of US$25 million; in 1962, less than 100 healthy, bearing trees remained of the 250,000 plantation trees on San Miguel Island (Bigornia *et al.*, 1980).

Fig. 2 Portion of a coconut grove affected with cadang-cadang. Note the few, short, erect leaves of the diseased palms.

Cadang-cadang incidence has declined since 1959 although substantial new infections and losses each year are still being experienced. The average number of estimated new infections in 1978 and 1980 was 300,000 resulting in an annual loss of 13,000 tons of copra valued at US$3.5 million (Zelazny and Pacumbaba, 1982). Surveys conducted in 1978 to 1986 in the Bicol region including Northern Samar showed that the largest number of new infections occurred in 1978 (Table 2). In 1980

Table 2 Biennial surveys of palms with new infection of cadang-cadang in the Philippines, 1978-1986

Province	Estimated number of new infections (Œ1000)				
	1978	1980	1982	1984	1986
Camarines Sur	347.5	151.0	64.1	87.7	72.8
Camarines Norte	79.0	45.7	22.8	45.7	53.6
Masbate	43.6	27.2	24.3	17.4	13.4
Albay	25.2	13.3	6.7	7.3	5.0
Sorsogon	22.4	27.3	6.3	7.2	12.7
Northern Samar	21.5	11.2	3.2	6.5	9.3
Catanduanes	2.3	2.1	0.9	0.9	1.5
Total	541.5	277.8	128.3	163.7	169.3

Source: E.P. Pacumbaba *et al.* 1988.

and 1982, the number of new infections decreased by about 50% and levelled off in the following years. The average number of new infections during the period was 256,120 palms. The estimated potential yield of these trees is 5,692 tons of copra valued US$2.1 million.

The outbreak of the disease is attributed to the age of the palms. When the disease broke out in the 1950s trees in plantations with 90% infection were cut and burned. Some groves were either rejuvenated or planted to other crops. The outbreak in 1978-1980 was not as serious as the one in the 1950s. The replants in the 1950s were 20-30 years old in 1978-1980, the age most vulnerable to the disease (Zelazny, 1980). Soil type, elevation and typhoons do not influence disease outbreak.

2) Management

Spread of the disease was reduced to 0.01%/yr from 1.04%/yr by eradicating the diseased trees. Rejuvenating plantations with resistant or tolerant varieties, like progenies of survivor palms, lowered the infection. Spraying with insecticides, cover cropping and fertilization did not control the disease. For management practices to be more effective, the method of transmission and spread of the disease must first be known.

2 Lethal wilt

The cause of the disease is unknown. However, an Aphelenchoid nematode was found to be associated with stem tissues of affected palms (Concibido *et al.*, 1984). Palms are killed 3-7 months after the infection (Fig. 3).

Presently, lethal wilt is confined in the Municipality of Socorro, Oriental Mindoro. Observed in the early 1960s in Mabuhay locality, it spread to Happy Valley and Subaan, and in 1978 to three other localities (Abad *et al.*, 1980).

In 1977, "Operation Socorro" was launched. This involved the cutting and burning of the infected trees to reduce the sources of inoculum and prevent the spread of the disease to new areas.

1) Outbreaks and losses

The total number of infected palms cut down from 1977 to 1983 in the different localities of Socorro varied from 1,190 to 2,900 trees, averaging 1,600 trees/yr (Table 3). This constitutes an annual loss of 14.3 tons of copra, valued at US$5,107.

The trend of disease incidence was decreasing, although the disease spread to other localities. This may be attributed to the cut and burn operation being conducted. The latest total number of infected trees was found in Mabuhay where the disease was first observed. The incidence of new infections from year to year indicates that the eradication of diseased palms alone will not control the disease especially if it has alternate host(s) and is disseminated by airborne vector(s).

2) Management

The eradication campaign against the disease has prevented disease outbreaks. More effective disease managements cannot be developed unless the etiology, method of transmission and host range are known. Different coconut varieties are now being tested for resistance to the disease.

Fig. 3 Coconut palms showing early (right) and advanced (left) symptoms of lethal wilt disease. Note drying of oldest fronds of palm in the early stage of infection and drying of the whole crown in the advanced stage.

Table 3 Number of lethal wilt-infected palms in 12 barangays of Socorro, Oriental Mindoro, Philippines, 1977-1983

Barangay	Number of infected palms (Œ1000)					
	1977	1978	1980	1981	1982	1983
Mabuhay	1.11	0.33	0.69	0.19	0.24	0.09
Happy Valley	0.14	0.09	0.09	0.64	0.18	0.05
Subaan	0.28	0.28	0.59	0.16	0.31	0.43
Batong Dalig	NR	0.04	0.08	0.02	0.03	0.03
Calubayan	NR	0.09	0.22	0.06	0.10	0.05
Monteverde	NR	0.37	1.32	0.12	0.11	0.17
Bayuin	NR	NR	NR	NR	0.15	0.33
Malugay	NR	NR	NR	NR	0.07	0.09
Pasi I	NR	NR	NR	NR	0.01	0.04
Pasi II	NR	NR	NR	NR	0.02	0.01
Villareal	NR	NR	NR	NR	0.13	0.04
Fortuna	NR	NR	NR	NR	NR	0.01
Total	1.53	1.20	2.99	1.19	1.35	1.34

Source: N.C. San Juan, 1984.
NR = No report

Sugarcane

Culmicolous smut

Smut, caused by *Ustilago scitaminea* Syd., is a major disease of sugarcane in the Philippines (Fig. 4). It was first observed in Alabang, Rizal in 1908, spread to various sugarcane areas attacking the commercial varieties POJ 2878 and Alunan in the 1930s and 1940s (Reyes *et al.*, 1980). Since 1955, sporadic outbreaks of smut were reported in Luzon and the Visayas, where the susceptible Hawaiian varieties H 44-3098, 37-1933 and 32-8590 were extensively grown. These varieties were later replaced with the new high-yielding varieties Phil 56226, 58260, and 5333, occupying 71% of the total area

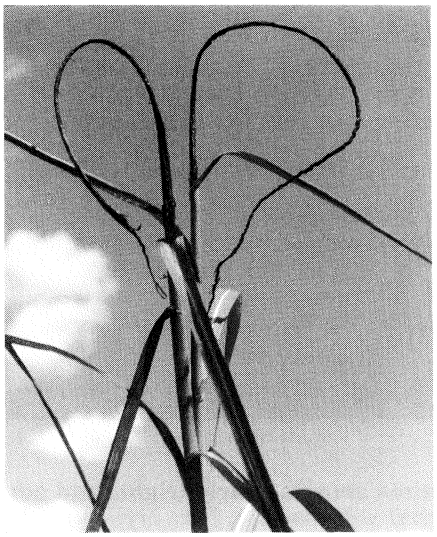

Fig. 4 Sugarcane shoots showing long, black, whip-like structures, the characteristic symptom of culmicolous smut.

planted to sugarcane.

1) Outbreaks and losses

Losses due to smut vary with the variety, weather conditions and kind of crop. In San Carlos Mill District, Negros Occidental, plant cane of Phil 56226 variety had 3.7% average smutted stools and the ratoon, 14.5% (Dosayla *et al.*, 1982). The yield loss in the district was 57,979 tons of cane equivalent to 1,564 tons of sugar valued at US$1.7 million.

Yield losses due to smut on varieties Phil 5333, 56226, 6019 and 56260 were 34.27, 66.70, 59.59 and 71.80%, respectively (San Pedro and Latiza, 1974). Smut infection on plant canes of NCo 310, Phil 56226 and Phil 58260 reduced the yield by 18.39, 19.44, and 15.67%, respectively (Estioko and Reyes, 1978). In Bogo-Medellin Mill District, Cebu, infection rate on plant canes in the crop year 1973-1974 ranged from 8.68 to 15.86%. The estimated loss in the district was 30,200 tons of cane equivalent to 3,078 tons of sugar valued at US$3.1 million.

The Philippine Sugar Statistics estimated a national average of 10% loss due to smut. Based on

Table 4 Area planted, percent area affected, average infection and estimated yield loss in four crop years in Hacienda Luisita, Tarlac, Philippines

Crop year	Area planted (Ha) Œ1000	Area affected (%)	Average infection (%)	Yield loss (ton/cane) Œ1000
1984-85	4.9	22.4	7.5	25.7
1985-86	4.9	33.2	5.5	16.1
1986-87	5.1	32.3	7.1	24.8
1987-88	5.1	32.1	6.8	28.5
Mean	5.0	30.0	6.7	23.8

Source: TDC (Tarlac Dev. Corp.) 1988.

the average production from 1971–1985, the annual yield loss amounted to 1.5 million tons of cane equivalent to 148,028 tons of sugar valued at US$147 million.

Smut monitoring for four consecutive crop years in Hacienda Luisita showed that the average infection rate ranged from 5.5 to 7.5% (Table 4). The highest yield loss was 28,500 tons of cane in the crop year 1987-1988, followed by the crop years 1984-1985 and 1986-1987 with 25,700 and 24,800 tons of cane, respectively.

The increase in smut infections and yield losses in the crop years 1984-1988 compared to the crop year 1980-1981 (infection 2%, yield loss, 7,000 tons of cane) is attributed to the change in the varieties planted and method of cane culture. In the crop year 1981-1982, TDC Management went into full mechanization. The existing varieties were replaced with new high-yielding ones suitable for full mechanization. A number of the varieties were smut susceptible. For mechanization to be profitable, the crop has to be ratooned longer, 4-5 years. This practice allowed the build-up of inoculum in the field and spread of the disease.

2) Management

Management of the disease includes the use of tolerant or resistant varieties, eradication of infected stools, use of disease-free sets, seedpiece treatment with fungicides, avoiding long ratooning and elimination of the weed hosts of the disease.

Abaca

Abaca mosaic

Mosaic is the most destructive disease of abaca in the Philippines (Fig. 5). It was first observed at the Odell Plantation and Ohta Development Company in Davao, Mindanao (Kent, 1954). During World War II, abaca plantations were neglected so the disease spread rapidly to other areas. In the 1960s many plantations in Mindanao were abandoned and planted to other crops.

1) Outbreaks and losses

The length of life of abaca plantations in relation to mosaic disease is 4 to 18 months for young

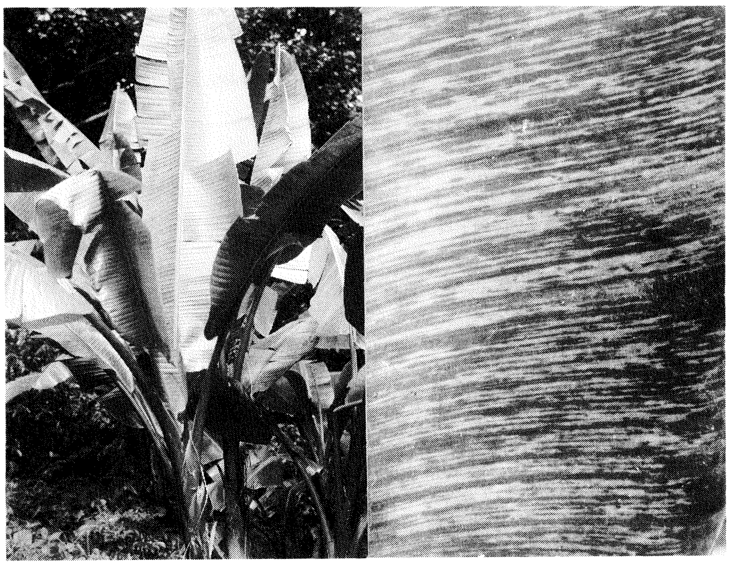

Fig. 5 Left, abaca plants in the advanced stage of mosaic infection showing rusty brown leaves. Right, a part of infected leaf showing yellowish streaks running parallel to the veins.

plantations interplanted with corn or surrounding areas planted to corn and 2.5 to 6 years in older plantations (Reinking, 1955). Of the 8,930 ha planted to abaca from 1946-1949 in Kidapawan, South Cotabato, 2,184 ha were abandoned in 1952 due to mosaic, the remaining 5,875 ha had 3-50% infections. In 1955, the 1,510 ha that remained of the original 8,930 ha had also 16-100% infection. Plantations with an aggregate area of 11,000 ha when still free from mosaic produced an average of 1,875 tons of fiber/mo. When the average mosaic infection reached about 80%, the yield went down to 750 tons of fiber/mo, a 60% yield reduction (Reinking, 1955).

The percentage of areas affected with mosaic in Albay and Camarines Sur, Bicol region has greatly increased since 1979 (Table 5). Of the total 49,000 ha of abaca land in 1987, 4,600 ha were mosaic-affected. The total number of mosaicked plants rogued and fiber yield loss were 3,459,900 and 924.5 tons, respectively. Albay suffered more losses than Camarines Sur.

Causes of outbreak and difficulty of controlling mosaic were the interplanting of corn with abaca or the growing of corn in areas close to abaca plantations and the use of mosaic-infected corns or suckers for planting in new areas. Corn acts as reservoir for the virus and is the most favorable host for breeding aphid vectors. Because of economic problems, the abaca regions have become general farming regions where any kind of crop can be grown. Abaca mosaic virus has also several insect vectors and alternate hosts making the control difficult.

2) Management

Severity and rapid spread of mosaic can be prevented by avoiding interplanting corn or

Table 5 Abaca mosaic affected area and percent, number of rogued plants and estimated yield loss in two Bicol provinces, 1979-1987

Year/province	Area Ha (Œ1000)	Affected % or abaca land	No. of plants rogued (Œ1000)	Yield loss (ton)
1979				
Albay	0.6	4.2	35.6	9.6
Camarines Sur	0.5	5.0	76.7	20.7
1980				
Albay	1.0	9.0	27.4	7.4
Camarines Sur	0.5	6.3	1.1	0.3
1982				
Albay	1.9	19.0	583.3	157.5
Camarines Sur	0.9	29.0	384.9	94.2
1984				
Albay	2.0	22.0	657.7	177.6
Camarines Sur	0.9	29.0	358.9	96.9
1986				
Albay	3.4	36.2	681.0	183.9
Camarines Sur	1.1	15.6	45.6	12.3
1987				
Albay	3.2	33.3	536.6	144.9
Camarines Sur	1.4	29.0	71.1	19.2
Total			3,459.9	924.5

Source: FIDA. 1988.
Estimated fiber yield loss was based on 1,111 plants/ha.

arrowroot with abaca, clean culture to remove the weed hosts, use of certified disease-free planting materials and resistant or tolerant varieties, like Musa Tex 50, 51, and 52, and cover cropping to keep down the growth of grass weeds which serve as hosts of the aphid vectors and reservoir of the virus. Spraying with insecticides against the vectors will also help prevent disease spread.

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Discussion

Nagarajan, S. (India): Do you have any organized program for breeding for resistance to the two virus diseases of coconut? Which organizations in the Philippines are in charge of these activities?

Answer: We have a program for cadang-cadang only. In the case of lethal wilt, resistant varieties from other countries are being screened. The organizations in charge are: The institute of Plant Breeding, UP, Los Banos and the Philippine Coconut Authority at the Research Station in Davao City.

Miyamoto, R.I. (Jamaica): The lethal yellowing disease is being controlled by resistant varieties (May Pen and Malaysian Dwarf) and by using specific ground covers which discourage the presence of the vector (leafhopper). Have the Philippine authorities undertaken any research on ground covers to control the vectors in the coconut plantations? If so which ground covers have been found to be effective?

Answer: Different coconut varieties in the Philippines including those introduced from Malaysia and Africa are being tested or screened for resistance to lethal wilt or Socorro wilt. No study on the effect of cover crops on the control of lethal wilt in the Philippines has been carried out.

Fajemisin, J.M. (IITA): You presented chronologically consistent estimates of yield losses for some selected diseases. Could you please elaborate on how these data were collected since this systematic yield loss estimation is deficient in many developing countries.

Answer: There are specific government agencies in charge of these crops. The agencies employ trained plant protection specialists. Monitoring of rice diseases and estimation of yield loss are performed by the National Crop Protection Centers in the different regions of the country and to a limited extent by the department of plant pathology of IRRI and UPLB; coconut by the Research Stations of the Philippine Coconut Authority and by the Bureau of Plant Industry, Department of Agriculture; abaca by the researchers (plant pathologists) of the Fiber Development Authority and the Bureau of Plant Industry; and sugarcane by plant pathologists of the Sugar Regulatory Authority.

Uritani, I. (Japan): 1. I have heard that in the Philippines cooking bananas and fruit bananas experience severe bacterial diseases. What kinds of diseases are important for bananas in relation to abaca? 2. In the Philippines Makapuno coconut palm is being propagated by tissue culture. Do you encounter any disease problem?

Answer: 1. Bacterial wilt caused by *Pseudomonas solanacearum* is not particularly serious on cooking and fruit bananas and abaca. Presently a serious disease of bananas that is related to abaca is bunchy top, a virus disease transmitted by the brown aphid *Pentalonia nigronervosa*. 2. Makapuno coconut palm is now being propagated by embryo culture. Foliar diseases observed on the few plants grown in Laguna include gray leaf spot (*Pestalozzia palmarum*) and leaf blight (*Helminthosporium* sp.). Makapuno coconut palm is susceptible to cadang-cadang.

Garcia, R.P. (The Philippines): I would like to know whether the figure you presented in the losses of copra represents only those due to cadang-cadang or to some other diseases.

Answer: The losses listed correspond only to those by cadang-cadang. Other diseases/disease complexes have never been accounted for. The estimation is based on the number of nuts/tree produced each year and the number of nuts involved in the production of 1kg of copra. The value is expressed in US$ or in pesos or volume in copra.