SURVEY OF INSECT PESTS AND DISEASES OF GABING SAN FERNANDO, *Xanthosoma sagittifolium* (L.) SCHOTT and MELET IN SELECTED AREAS OF LUZON AND ZAMBOANGA CITY, PHILIPPINES

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ABSTRACT

Different insect pests were observed on Gabing San Fernando (GSF) (*Xanthosoma sagittifolium* (L) Schott and Melet) in GSF growing areas in Luzon and Zamboanga City, Philippines through monitoring conducted from August, 2015 to October, 2016. The most prevalent were the leaf feeders, 'harabas' or cutworm (*Spodoptera litura* Fabricius) and the wooly bear caterpillar (*Olepa ricini* Fabricius). The striped albatross caterpillar (*Appias olferna peducaea* Fruhstorfer), noted in Kasibu, Nueva Vizcaya is a novel host that will be of interest to butterfly breeders and has potential for livelihood. Tussock moth caterpillar (*Orgyia spp*.) attacked GSF occasionally at the Central Experiment Station of University of the Philippines Los Baños (UPLB), and the National Crop Protection Center (NCPC) experimental plots. The lepidopterous pests' damage only affects 2-3 leaves and 1-2 plants. Banana aphids (*Pentalonia nigronervosa* Cocquerel) were also found in the inner stalk at the NCPC area. The aphids were suspected vectors of the virus, Dasheen Mosaic (DsMV). Majority of the surveyed areas had 2 or 3 plants with DsMV symptoms but remained healthy. It was observed that the GSF populations in most areas were resistant to DsMV. Notable among the destructive insects found attacking GSF was the grub of the coconut rhinoceros beetle (*Oryctes rhinoceros* Linnaeus), covered with decaying debris and found feeding in the corm. The infested GSF had dried leaves. Other insects were observed on GSF plants but they were occasional dwellers, transient visitors, and many were beneficials. The insect pests, disease and beneficials are new records for GSF in the Philippines.

Key words: leaf feeders, new records

INTRODUCTION

Gabing San Fernando (GSF) or *Xanthosoma sagittifolium (*L.) Schott and Melet belongs to the Araceae family or Aroids. Almost similar to Taro (*Colocasia esculenta* [L.]), GSF, also known as the arrow leaf elephant ear, is an important tropical and subtropical tuber crop grown in several countries in the world. Its corms and cormels are consumed as staple or subsistence food in developing countries (Lokesh et al. 2014). The *Xanthosoma* species are plants of the tropical rain forest and, although in their natural habitat they grow under the forest canopy. Under cultivation, they are usually sown with full exposure to sunlight. They require well-drained soils and do not tolerate the permanent presence of water. The mean temperature for their optimum growth must exceed 20°C (Bermejo and De Leon 1994). In reality, aroids are fairly robust plants with leathery leaves, which are difficult for most insects to chew. As a group, these are often left to grow without pesticides and still manage to produce significant yields. There are, however, several pests and disease which deserve attention, especially in intensive, commercial production (Lebot 2009). Compared to *Colocasia* and other root and tuber crops, GSF is

supposedly resistant to pests and disease. However, there were reports of pest infestation of the plant from farmers. In a study by Pillai et al. (1993), however, yield losses of up to 29% was noted due to infestation of *C. esculenta*, *X. sagittifolium* and *Amorphophallus sp*. by *Spodoptera litura*, *Aphis gossypii* Glover and spider mites [*Tetranychidae*].

Mealybugs, which are injurious on tuber crops, also infest *Xanthosoma sagittifolium*, although mainly cassava, taro, yam, sweet potato, elephant foot yam, and yam bean are much more affected. (Mani et al. 2016). On the other hand, Coleson and Miller (2005) found out that *X. sagittifolium* consistently exhibited strong aphid resistance (antixenosis), specifically on *Aphis gosyphii* than in taro (*Colocasia esculenta*).

Xanthosoma does not suffer from any severe pests or disease in the Pacific islands (Weightman and Moros 1982 as cited by Manner 2011). However, in the Caribbean, its pests include nematodes, a hairy caterpillar, mealybug, cotton lace bug, woolly aphids, scale insects, and red spider mites. Other pests include wireworms, white grubs, and a smooth, black or dark brown boring caterpillar (Morton 1972). Dasheen mosaic virus (DsMV) is the most important viral pathogen of cultivated aroids world-wide (Chen et al. 2001). Viruses, however, do not appear to be a serious problem for *X. sagittifolium* (Kay 1987), although Castro (2006) mentioned that DsMV is the most important virus problem in Nicaragua. Other infrequent pests include *Aphis gossypii* in the Antilles and Surinam, *Euetheola bidentata* in Surinam, *Graphocephala propior*, *Quinta cannae*, and *Cacographis ortholatis* in Venezuela, *Aspidiotus destructor* in the Antilles and Polynesia, and *Pentalonia nigronervosa*, *Tetraleurodes ursorum*, and *Corythucha gossypii* in the Antilles (Manner 2011; Reddy 2015).

This paper presents some insects observed to attack GSF through a survey and monitoring conducted in different areas of Luzon and Mindanao, Philippines. The survey also includes the beneficial arthropods that have been observed in GSF plants and relates the pest management practices on some of the prevalent pests that attacked GSF.

METHODOLOGY

The monitoring, identification, and assessment of insect pests, diseases and beneficials on GSF plants were done in four ways. First, there was the establishment of GSF plots in the NCPC experimental area, and weekly monitoring of the plants within their growing period until harvest. Second, there was weekly monitoring of the three GSF experiments and a GSF production area established at the Central Experiment Station of UPLB-College of Agriculture. Third, there was periodic monitoring of GSF areas in farmers' fields in the neighboring municipalities/city of San Pablo City, Bay, and Los Baños in Laguna province, and in Dolores, Lucena, Lucban, and Pagbilao of Quezon province. Fourth, there was a one-time observation in some GSF areas in the country, like in Mindanao, during the extensive germplasm collections. The monitoring was made from August 2015 to October 2016.

Insect pests and diseases were collected, identified, damage characterized, and documented through photos. The assessment of the pest and disease infestation was based on their occurrence, succession, frequency, and seasonality. The incidence of viruses in the GSF plants was also assessed with monitoring of insect vectors that may carry the virus.

RESULTS AND DISCUSSION

A total of 14 insect pests, one disease (Table 1), and 8 beneficial arthropods (Table 2) were observed to attack GSF during the monitoring period.

Notable among the insect pests that have brought considerable damage to one or two plants/leaves were the 'harabas' or common cut worm (*Spodoptera litura* Fabricius), banana aphid (*Pentalonia nigronervosa* Cocquerel) (Fig. 1), the wooly bear caterpillar (*Olepa ricini* Fabricius) a new pest of crops and weeds in the Philippines (Cayabyab et al. 2015), and the Tussock moth caterpillar (*Orgyia spp*. Ochsenheimer) (Fig. 2).

There were, however, other insect pests on GSF but were few in numbers on the leaves and stalks of the plant, namely, the grey mealy bug (*Ferrisia virgata* Cockerell), pineapple mealybug (*Dysmicoccus brevipes* Cockerell), and cottony cushion scale (*Planococcus lilacinus* Cockerell) (Fig. 3). Other insects which were occasional pests of GSF were the spiralling white fly (*Aleurodicus dispersus* Russell), long horn grasshopper (*Phaneroptera furcifera* Stål), bag worm (Psychidae), citrus grasshopper (*Melecodes tenebrosa* Walker), taro grasshopper (*Gesonula mundata zonocera*) (Navás 1904), and rice grasshopper (*Oxya hyla* Serville). The striped albatross caterpillar (*Appias olferna peducaea* Fruhstorfer) noted in Kasibu, Nueva Vizcaya, is a novel host for GSF that will be of interest to butterfly breeders and has potential for livelihood (Fig. 4).

(a) (b)

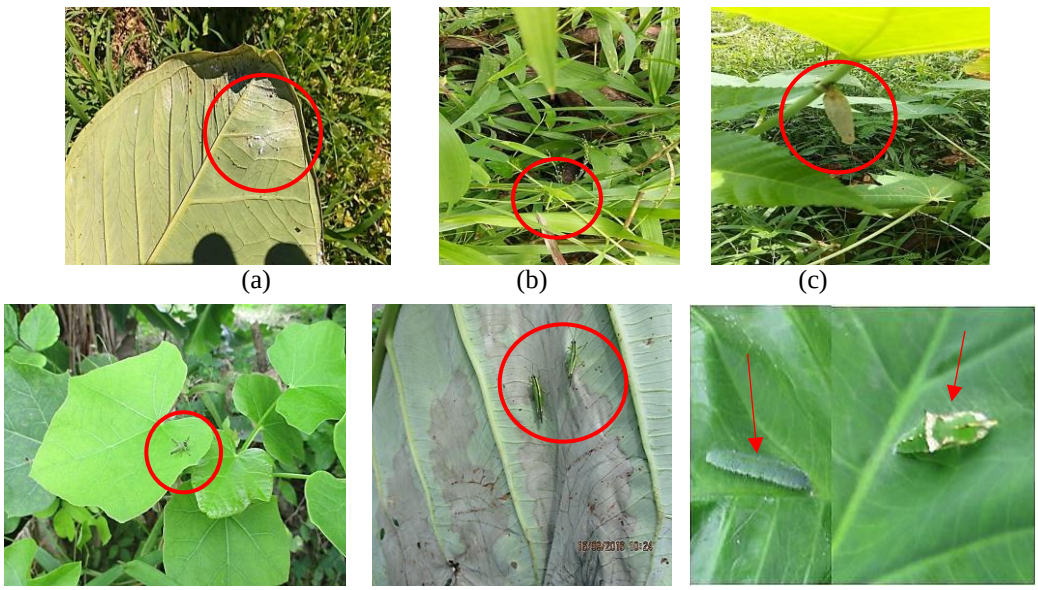
Fig. 1. Harabas or common cut worm on leaves (*Spodoptera litura* Fabricius) (a) and aphids (*Pentalonia nigronervosa Cocquerel)* (b) on inner stalk of GSF.

(a) (b)

Fig. 2. Wooly bear caterpillar (*Olepa ricini* Fabricius) (a), and Tussock moth caterpillar (*Orgyia spp*. Ochsenheimer) (b).

(a) (b) (c)

Fig. 3. Grey mealybug (*Ferrisia virgata* Cockerell) (a), Pineapple mealybug (*Dysmicoccus brevipes* Cockerell) (b), and Cottony cushion scale (*Planococcus lilacinus* Cockerell) (c).



(a) (b) (c)

(d) (e) (f)

Fig. 4. Spiraling white fly (*Aleurodicus dispersus* Russell) (a), Long horn grasshopper (*Phaneroptera furcifera* Stål) (b), Bag worm (*Psychidae*) (c), Citrus grasshopper (*Melecodes tenebrosa* Walker) (d), Rice grasshopper (*Oxya hyla* Serville) (e), and the Striped albatross butterfly caterpillar (*Appias olferna peducaea* Fruhstorfer) (f).

Another insect pest that was observed in GSF was the grub of the coconut rhinoceros beetle (*Oryctes rhinoceros* (Linnaeus). It was found feeding on the corm of the GSF at Dolores, Quezon. The usual host of the rhinoceros beetle are old decaying trunks of fallen coconut and its living trees. *Oryctes rhinoceros* (L.) is one of the most damaging insects to palms in Asia and the Pacific Islands (Giblin-Davis 2001). Adults are a major pest of *Cocos nucifera* (L.) and *Elaeis guineensis* Jacq. (Giblin-Davis 2001), but so are minor pests of many other palms and other plant species. By feeding on healthy leaves, the *Oryctes rhinoceros* causes physical damage, which can stunt growth and lead to secondary infections from bacteria or fungi (Hinckley 1973; Castro 2006). As was observed, GSF affected plants due to the feeding damage, and plants turned yellow, senesced and died (Fig. 5). This is a new finding for this insect pest which feeds on GSF as an alternate host.

(a) (b)

Fig. 5. Rhinoceros beetle (*Oryctes rhinoceros* (L.) damage (a) and grub (b) on GSF.

Most of the GSF plants observed in different parts of Luzon and Zamboanga City, Mindanao, where the survey was made, showed the presence of the Dasheen Mosaic virus (DsMV) (Fig. 6). DsMV incidence, however, did not show heavy infection and did not indicate a risk or grave threat. There were GSF plants in a population that do not show the symptoms and if infected, only 1 to 3 plants were affected and did not succumb to death. This is consistent with the findings that GSF is resistant to diseases and insect attack (Crop Protection Compendium (Open Source); Lebot 2009). However, depending on the host-virus strain combination and the location, DsMV can severely impact yields of the edible aroids *Colocasia* and *Xanthosoma* in the Pacific (Nelson 2008).

Fig. 6. Dasheen Mosaic Virus (DsMV) symptoms observed in GSF leaves.

DsMV is a typical member of the genus Potyvirus, and the most important viral pathogen of cultivated aroid plants worldwide, including the genera Aglaonema, Alocasia, Amorphophallus, Anthurium, Arisaema, Caladium, Colocasia, Cryptocoryne, Dieffenbachia, Monstera, Philodendron, Richardia, Spathiphyllum, Xanthosoma and Zantedeschia (Chen et al. 2001).

All of the above results related to GSF insect pest, disease and beneficials are new records in the Philippines and serve as benchmark data. It is also imperative to conduct a regular inventory of pests and diseases of GSF to check for threats on this alternative crop used as animal feed and food for human consumption.

Table 1. Insect pests on GSF observed at different locations in Luzon.

Location	Insect/Disease Pest Observed	Date(s) Observed	Severity		
			Frequency	Number / Appearance	Prevalence
CES, UPLB	Cut worm	September 2015 November 2015	Occasional	1 - 2	seen in 2 GSF plant
	Virus	February–November 2015	Occasional	As mosaic	3-5 GSF plant affected
NCPC, UPLB	Banana aphids	November 2015	Occasional	>20 as colony	Only 1 GSF affected
	Wooly bear caterpillar	July 11, 2016	Occasional	4-5	1 GSF attacked
	Tussock moth caterpillar	December 3, 2015	Occasional	3-4	1 GSF attacked
	Virus	December 3, 2015	Occasional	As mosaic	3-5 GSF plant affected
	Grey mealy bug	Sept – Nov., 2015	Occasional	>10	3-5 GSF plant affected
	Pineapple mealy bug	Sept – Nov., 2015	Occasional	>10	4-5 GSF plant affected
Dolores, Quezon	Cut worm	September 16, 2016	Occasional	2-3	1 GSF attacked
	Rhinoceros beetle grubs	September 16, 2016	Occasional	1	1 GSF plant attacked
	Virus	September 16, 2016	Occasional	As mosaic	4-5 plant affected
Lucena, Quezon	Long horn grasshopper (Katydid)	October 21, 2016	Occasional	1	1-2 found in plant
	Bag worm (Psychidae)	May 25, 2016	Occasional	1	Found in 1 GSF
Pagbilao, Quezon	Long horn grasshopper (Katydid)	October 21, 2016	Occasional	1	Found in 1 GSF
	Cottony cushion scale	October 21, 2016	Occasional	>10	Colony found in 3 GSF
Kasibu, Nueva Vizcaya	Striped albatross caterpillar	February 12, 2016	Occasional	1-3	2-3 found in >10 GSF plants
Lucena City	Citrus grasshopper	May 25, 2016	Occasional	1	Found in 1 GSF
	Virus	September 16, 2016	Occasional	As mosaic	3-5 GSF plant affected
Aurora, Quezon	Spiraling white fly	April 22, 2016	Occasional	5-10	3-4 GSF with colonies
	Rice grasshopper	April 22, 2016	Occasional	2	Found in 1 GSF
	Virus	April 22, 2016	Occasional	As mosaic	4-6 GSF plant affected
Zamboanga City	Virus	October 06, 2016	Occasional	As mosaic	4-6 gsf affected

Beneficial

A number of beneficial insects were also observed during the survey (Table 2). The orb weaver spider (*Argiope spp*.), crab spider (*Misumena sp*.), and huntsman spider (*Heteropoda venatoria* Linnaeus) helped in the reduction or elimination of insect pests that attack GSF. Other predators, such as the yellow crazy ants (*Anoplolepis gracilipes* Smith) and praying mantis (*Mantis religiosa* Linnaeus), were observed. Natural enemies are often encountered in the growing of crops. Palaniswami and Pillai (1980) found *Aphis gossypii* to be parasitized by the aphelinid *Aphelinus mali* (Hald.), a species of *Coccophagus* (*C. cowperi* Gir.) and by the encrytid *Aphidencyrtus aphiivorus* (Mayr).

The passerine birds, Maya, (*Passer montanus (*Linnaeus) were frequently observed in the GSF surroundings, and as such, their contribution in reducing pest population cannot be discounted for.

Table 2. Beneficial insects/natural enemies.

Location	Beneficial Insect Observed	Date(s) Observed	Severity	
			Frequency	Prevalence
CES, UPLB	House spider	November, 2015	Occasional	1
	Orb weaver	October 21, 2016	Occasional	1
	Crab spider	October 21, 2016	Occasional	1
NCPC, UPLB	House spider	November, 2015	Occasional	1
	Orb weaver	November, 2015	Occasional	1
	Crab spider	October, 2015	Occasional	1
Lucban, Quezon	House spider	October 21, 2016	Occasional	1
	Orb weaver	October 21, 2016	Occasional	1
	Crab spider	October 21, 2016	Occasional	1
Lucena, Quezon	Yellow crazy ants	October 21, 2016	Occasional	3-5
	Lady Bug (Coccinelid Beetle)	October 21, 2016	Occasional	1
	Yellow coccinelid beetle	October 21, 2016	Occasional	1
	Black coccinelid beetle	October 21, 2016	Occasional	1
Pagbilao, Quezon	Black ant	October 21, 2016	Occasional	3-5
Lucena City	Crab spider	October 21, 2016	Occasional	1
Aurora, Quezon	Praying mantis	May 25, 2016	Occasional	1

Pest management on Gabing San Fernando

Cut worms, as mentioned earlier, were observed on two occasions infesting GSF planted in the experimental area of Central Experiment Station (C8), UPLB, while banana aphids (*Pentalonia nigronervosa* Cocquerel) were seen at the lower stalk of GSF planted at NCPC, UPLB experimental plots. The presence of these two insect pests, however, did not pose a major threat and the extent of damage was not large enough to be considered a problem. But to ensure a rational management approach, the former was controlled by spraying a biological control agent, nucleopolyhedrosis virus (NPV), from NCPC, while the banana aphid was controlled by spraying a combination of cypermethrin 5 EC and thiocarbamate (cartap hydrochloride ES) at rate of 1.125L a.i/ha and 1.25kg a.i./ha, respectively (Cayabyab et al. 2015).

The infestations of wooly bear caterpillar (*Olepa ricini Fabricius*) and Tussock moth caterpillar (*Orgyia spp*) were only sporadic and very limited. Hence, their larvae were only mechanically crushed. No further presence or incidence of these insects was observed thereafter.

CONCLUSION

Insect pests namely, cutworm/'harabas' (*Spodoptera litura* Fabricius), Tussock moth (*Orgyia spp*.), and wooly bear caterpillar (*Olepa ricini* Fabricius) attacked GSF in certain occasions but their infrequent presence do not pose a major threat to the growing of GSF. This suggests that these insects attacked the GSF in cases when their most preferred hosts are not present. Occasional occurrence of the said pest was observed in the months of September to February, but their population was not sufficient to cause alarm. A nucleopolyhedrosis virus (NPV) from NCPC was used to control cutworms.

The presence of banana aphids (*Pentalonia nigronervosa* Cocquerel) in the GSF stalks may indicate the possibility for the insect to be carriers of DsMV, since the typical symptoms were noted. Its incidence, however, in most GSF planting sites pose minor problem to the growth of GSF as it did not severely affect the plants. The observed estimate of affected plants was only 1 – 3% in a GSF planting area, while banana aphids were controlled by spraying a combination of cypermethrin and thiocarbamate. Regular monitoring of pest and diseases of GSF is recommended for a pre-emptive management strategy to avoid or lessen damage.

There is a need to seriously consider the emerging threat of rhinoceros beetle to the growth of GSF in an area where coconuts and other palms are abundant because the grubs can cause severe damage that can affect the quality of the corms and the cormels produced.

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REFERENCES

Bermejo, J.E.H. and J. De Leon. 1994. Neglected Crops. 1492 from a different perspective. Food and Agriculture Organization (FAO) Plant Production and Protection Series No.26. FAO, Rome, Italy.

Castro, G.R. 2006. Studies on cocoyam (*Xanthosoma* spp.) in Nicaragua, with emphasis on Dasheen mosaic virus. Doctoral thesis, Dept. of Plant Biology and Forest Genetics, Swedish University of Agricultural Sciences, Uppsala, Sweden. 33p.

Cayabyab, B. F., Villavicencio, E.B., Villancio V. T. and J.N. M Garcia. 2015. Some insect pests of Gabing San Fernando (GSF) (*Xanthosoma sagittifolium* (L) Schott and Melet). Leaflet.

Coleson, J. L. and R.H. Miller. 2005. Antibiosis and antixenosis to *Aphis gossypii* (Homoptera: Aphididae) in *Colocasia esculenta*. J Econ Entomol. 98(3): 996-1006

Crop Protection Compendium (The world's most comprehensive site for Crop Protection Information). www.cabi.org – Open Source.

Giblin-Davis, R. 2001. Insects on palms. CABI Publishing, Wallingford Great Britain. 400 p.

Hinckley, A. D. 1973. Ecology of the coconut rhinoceros beetle, *Oryctes rhinoceros* (L.) (Coleoptera: Dynastidae). Biotropica 5(2): 111-116.

Kay, D.E. 1987. Root Crops. Second Edition (revised by E.G.B. Gooding). Crop and Product Digest No. 2. Tropical Development and Research Institute, London.

Lebot, V. 2009. Tropical roots and tuber crops. Major pests and diseases of Aroids. Crop Production Science in Horticulture, CABI: Wallingford, U.K. 17. Ch. 27:239 – 342.

Lokesh, M., Patil, S, Nagesh S., Naik, V., Prashantha, A. and K. Chandan. 2014. Evaluation of germplasms of *Colocasia esculenta* (L.) Schott and *Xanthosoma sagittifolium* (L.) (Schott and

Melet) against leaf blight (*Phytophthora colocasiae* Raciborski.) in Central Western Ghats of Uttara Kannada of Karnataka in India. Int. J. Adv. Res. Biol. Sci.; 1(6):180-184

Mani, M., Kalyanasundaram, M., Jayaprakas, C.A., Harish, E.R., Sreerag, R.S. and M. Nedunchezhiyan. 2016. Tuber Crops. Chapter 54: 471-494. Mealybugs and their management in agricultural and horticultural crops. Springer India.

Manner, H.I. 2011 Farm and forestry production and marketing profile for Tannia (*Xanthosoma* spp.). In: Elevitch, C.R. (Ed.). Specialty Crops for Pacific Island Agroforestry. Permanent Agriculture Resources (PAR), Holualoa, Hawai'i. http://agroforestry.net/scps

Morton, J.F. 1972. Cocoyams (*Xanthosoma caracu*, *X. atrovirens* and *X. nigrum*), ancient root-and leaf-vegetables, gaining in economic importance. Proceedings of the Florida State Horticultural Society, 85: 85–94.

Navás. 1904. Notes zoológicas. VI. Excursión de la Sociedad Aragonosa de Ciencias Naturales a la Sierra de Guara. Boletín de la Sociedad Aragonesa de Ciencias Naturales (Bol. Soc. Arag. Cienc. Nat.) 3:190-201.

Nelson, S. C. 2008. Dasheen mosaic of edible and ornamental aroids. Plant Disease. Series Report Plant Disease #44 .9p.

Palaniswami, M.S. and K.S. Pillai. 1980. Parasites on *Aphis gossypii* G: infesting taro and tannia. Current Science (Letters to the Editor). 49(21): 830pp.

Pillai, K.S., Palaniswami, M.S., Rajamma, P., Mohandas, C. and C.A. Jayaprakas. 1993. Pest management in tuber crops. Indian Horticulture. 38(3):20-23.

Weightman, B.L. and I.M. Moros. 1982. The cultivation of taro *Xanthosoma* sp. In: M. Lambert. Taro Cultivation in the South Pacific. SPC Handbook No. 22: 74–83. South Pacific Commission, Noumea, New Caledonia.