2014 International Conference on Intelligent Agriculture
IPCBEE vol.63 (2014) © (2014) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2014. V63. 5

Farmers' Perceptions about Banana Insect Pests and Integrated Pest Management (IPM) Systems in SocSarGen, Mindanao, Philippines

Catherine Hazel Aguilar[+], Florence Lasalita-Zapico, Jaime Namocatcat, Abegail Fortich and Rea Mae Bojadores

Science Department, College of Natural Sciences and Mathematics, Mindanao State University-Fatima, General Santos City, 9500, Philippines

Abstract. On-site insect pest surveys and interviews with banana farmers in four banana-growing areas in SOCSARGEN (South Cotabato, Sarangani Province, General Santos City), Mindanao were undertaken to determine the incidence of insect pests as well as farmers' views and perceptions about integrated pest management as a system for pest control. In all four sites, insect pests such as black aphid (Pentalonia nigronervosa), stem weevil (Odoiporus longicollis), brown aphid (Toxoptera citricida), lace bug (Stephanitis typica), stalk fly (Telostylinus lineolatus), spiraling whitefly (Aleurodicus disperses), corm weevil (Cosmopolites sordidus) Chinese rose beetle (Adoretus sinicus) and mealy bug (Dysmicoccus neobrevipes) inflicted different types of damage to banana plants. Survey results revealed that banana production is severely hampered by viral and pest infestation, declining soil fertility, Fusarium wilt and other problems. While all farmers use a wide array of IPM methods in their farms, a significant number believe that these are insufficient in bringing down pest populations. A few are seriously considering the use of synthetic inputs as a viable farming alternative. Though representing only four banana-growing areas, the study nonetheless provides baseline information about pest incidence and IPM strategies used by farmers in SOCSARGEN banana plantations where no such documented reports are available.

Keywords: banana, insects, Insect Pest Management, SOCSARGEN, Philippines

1. Introduction

Banana is a major cash crop and an important staple to millions of people in developing countries in the humid tropics and subtropics [1]. In the Philippines, about 90% of the total production is locally consumed while a paltry 10% is exported to international markets [2, 3]. This low trade volume speaks of the importance of banana as a major calorie source for poverty-stricken people in the country. In rural areas, backyard banana plants ensure food security at the household level especially during the lean months of rice and corn production. Moreover, due to its non-invasive, persistent and adaptive nature, banana is an ideal component of tropical/subtropical agro-forestry settings and for intercropping in highly diversified systems.

Banana production has sustained livelihoods in the Philippines for a very long time. Over that period, productivity has faced several constraints, the major ones being declining soil fertility, pest/disease infestation, poor crop management and poorly developed production and marketing systems [4]. Since bananas grow in diverse farming systems, they are exposed to a multitude of pests which affect different plant parts, wreak considerable damage to the plant at all stages of development and consequently reduce yield and fruit quality. In this study, banana pests infesting banana plantations in SOCSARGEN were identified and management strategies for their control were evaluated using farmer knowledge and experiences. The identification of natural enemies and predators of banana pests is expected to aid in the

[+] Corresponding author
E-mail address: cathy_aguilar16@yahoo.com

formulation of sustainable non-chemical alternative strategies for the eradication of banana pests, thereby minimizing the dependence of banana farmers on chemical pesticides. The evaluation of management strategies employed by banana farmers will also help in the development of more effective pest control strategies that will benefit them through the reduction of pre- and post-harvest losses due to pest infestation.

2. Materials and Methods

2.1 Habitat Characterization, Insect Survey and Identification

Banana smallholder plantation areas utilizing the organic method of farming were identified in Katangawan (General Santos City), Malapatan (Sarangani Province) and Tupi and Polomolok (South Cotabato). These plantation areas were geo-located using GPS and subjected to in situ habitat characterization. Insect populations were sampled using a combination of techniques described by Sutherland [5]. Monthly monitoring of insect pest incidence was done for six months through timed cruising method, sweep netting, pitfall traps, flight interception traps and visual inspection of the ground areas, banana trunks and canopy. Banana trunks that had been cut, showed signs of viral infestation or had toppled over were dissected and examined closely for the presence of weevils and viral insect vectors (i.e. aphids). All collected samples were first processed then sorted, classified, and identified down to the species level whenever possible.

2.2 Farmer Survey and Data Analysis

Documentation of on-farm practices to control insect pest infestation in smallholder banana farms was carried out using a three-tiered semi-structured survey questionnaire based on Deng et al [6], Tiwari et al [7], Kamanula et al [8] and Mugisha-Kamatenesi et al [9]. The first part dealt with demographic profiles of the farmer respondents while the second part extracted information about their farms and farming practices. The third part of the survey documented the IPM practices used by banana farmers as well as their purported health and environmental benefits. Thirty one (31) farmers were chosen and their views and perceptions about constraints in banana farming and IPM strategies were elicited in a participatory process. These were key informants who were responsible for decision making in the farms. Collected data were collated, analyzed using descriptive statistics and expressed as means or percentages

3. Results

3.1 Habitat Characterization and Insect Survey

Four study sites (fig.1) in banana-growing areas in South Cotabato, Sarangani Province and General Santos were selected for the study. The first study site was a two-hectare Bungolan plantation in El Nama, Polonuling, Tupi, South Cotabato (06°18’24.0N, 124°57’37.5E) with a recorded altitude of 385 m. Poor sanitation and cultural management however had resulted in widespread bunchy top infestation in the area. Having the loam soil type, abounding flora growing with banana consisted of a profusion of ferns, coconut and weeds. The insect pests found in the Tupi banana plantation were *Pentalonia nigronervosa, Cosmopolites sordidus, Stephanitis typica, Dysmicoccus neobrevipes* and several species of beetles.

The second banana farm in Purok Masikap, Pagalungan, Polomolok (06°14'24.0N, 125°02’55.8E) had an elevation of 379 meters. It consisted of a two-hectare parcel of land planted to *Lakatan* banana. Located in the foothills of a dormant volcano, Mt. Matutum and flanked on all sides by Dole pineapple plantations, this smallholder plantation was well-maintained and routinely cleaned. Cursory observation of the banana plants, however, revealed several cases of bunchy top and mosaic virus infestation. Coconut was planted in the periphery of the banana plantation along with some vegetable crops such as tomato and bell pepper which are known to harbor aphid vectors on the undersides of their leaves. In the area, insect pests such as *Pentalonia nigronervosa, Odoiporus longicollis, Toxoptera citricida, Stephanitis typica, Telostylinus lineolatus Dysmicoccus neobrevipes, Aleurodicus disperses* and four species of beetles were found to cause considerable damage in banana plants.

The third study site was a 3.5 hectare plantation in Barangay Katangawan, General Santos City ($06^0$11'43.1' N, $125^0$13'36.9'E) planted with the *Cardava* type of banana for local markets. The soil type was

clay loam with predominant flora consisting of a wide range of weeds and coconut. The area was prone to flooding during rainy months because of overflowing of water from a nearby irrigation ditch. The floods at times submerge the banana farm in about 12 inches of water for days and periodically cause Moko outbreaks which were twice seen during monthly monitoring. Major insect pests causing considerable damage to banana plants in Katangawan were *Dysmicoccus neobrevipes, Aleurodicus disperses, Stephanitis typica, Cosmopolites sordidus* and *Adoretus sinicus*.

The fourth study site was a banana farm in Purok Marielle, Barangay Lun Padidu, Malapatan, Sarangani Province (06^{0}02'25.5"N 125^{0}18'03.4"E) which had an elevation of 27meters. This 2.5 hectare, privately-owned farm was planted with *Cardava* banana and had a lush growth of cogon grass and a wide assortment of weeds due to lack of routine sanitation and clearing. What was noteworthy about this study site was the very high incidence of sooty mold in the banana population stands in the area. Insect survey for this site indicated that major pests attacking banana plants were *Dysmicoccus neobrevipes, Aleurodicus disperses, Stephanitis typica* and *Cosmopolites sordidus.*

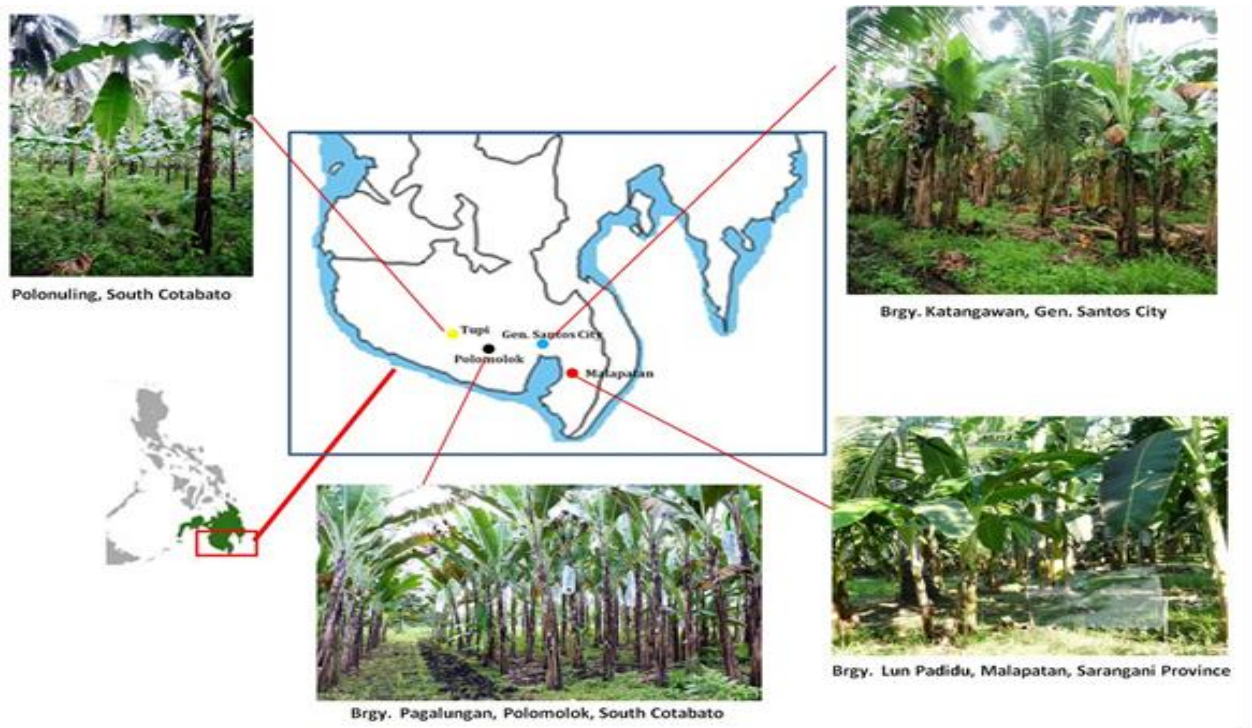

Fig. 1. Location map of study sites

3.2 Farmer and Farm Profile

Thirty one (31) key informants were chosen for this study of which 65% were males and 35% were females. Approximately 63% of the farmers interviewed were of Visayan lineage, 21% came from the upland areas and the rest came from Mindanao and Luzon provinces. Their ages ranged from 22-67 years with a mean age of 44.4 years. Majority of the farmers that made up the workforce in the fields belonged to the 41-50 years age bracket. On the other hand, younger farmers (20-30 years) and elderly farmers (61-70 years) collectively comprised the minority. In terms of their scholastic background, majority of the farmers (65%) had 7-13 years of formal education while the rest had little/ no education at all (0-3 years). Households of banana farmers had a range of 3-16 persons per family and relied heavily on banana farming as their main revenue source. They earn additional income, however, from small scale business (retail stores) and crop and livestock production. As regards gender roles in banana farming, duties and responsibilities were not clearly delineated in the farms. Women also took part in all activities done by men such as planting, deleafing, harvesting, organic fertilizer application and weeding to name a few.

Farm sizes ranged from 0.5-12 hectares and were owned by 68% of the banana farmers. The banana varieties planted in the fields were *Bungolan, Lakatan, Cardava, Morado* and *Latundan*. Oftentimes, the banana plants were intercropped with coconut by majority of the farmers along with peanuts, corn, squash, coffee and yams. Production constraints identified by farmers in order of decreasing importance include: pest/disease infestation, declining soil fertility, Fusarium wilt infestation and low productivity.

3.3 Pest Control

In this study, almost all of the farmers (97%) were found to be using IPM strategies for pest control while the remaining 3% combined IPM with chemical use. Reasons farmers gave for using IPM were varied and mostly related to the health and environmental benefits associated with this method of pest control. A few farmers also disclosed that IPM techniques are cheaper than synthetic inputs and had been vouched for by friends and neighbours to be singularly effective. Furthermore, a last group of farmers working in the *Bungolan* plantation disclosed that they adhere to IPM use as per stipulation in their contract with the banana exporting facility that buys their produce. Moreover, having minimal mechanization and artificial chemical inputs, all the farms used organic inputs (Table 1) instead and IPM strategies to keep pest populations in check. Among these were the use of biological insecticides and enemy plants, manual clearing, smoking and crop rotation. Among the various concoctions used by the farmers were: Oriental Herbal Nutrient and GIN-DU-LUY in various proportions (Table 1). These biological insecticides are cheaper, mainly organic, and biodegradable and are not injurious to human and environmental health. All farmers who had been hitherto using these concoctions attest to their efficacy, though they said that preparation and application of these organic pesticides could be laborious and time consuming. When asked about the perceived effectiveness of IPM for insect control, 65% of the farmers bespoke of its effectiveness, 19% replied that it was just moderately effective while the remaining 16% declined to give an answer. Conversations with farmers also revealed lack of knowledge about insect pests, the damage that they cause to crops and the capability of certain insects to transmit viruses. Several farmers, especially those having *lakatan* and *latundan* in their fields were considering shifting to modern technologies (chemical fertilizers and pesticides) to increase banana productivity.

Table 1. Plant and animal products used in organic banana farming

Code	**Name**	**Composition**	**Function**
FPJ	Fermented Plant Juice	2:1 green vegetable leaf; Muscovado sugar	organic fertilizer
FAA	Fish Amino Acid	1:1 Fish scales, entrails etc; Muscovado sugar	organic fertilizer
OHN	Oriental Herbal Nutrient	4:1:5 Ginger;Muscovado Sugar; gin	pesticide
Gin-Du-Luy	Gin-Dulaw-Luya	0.5:0.5:1 ginger: turmeric: Gin	pesticide

3.4 Beneficial Insects and Enemy Plants

In Katangawan and Lun Padidu, identified natural enemies of insects were spiders, mealy bug predator (*Cryptolaemus montrouzieri*) and earwig (*Forficula auricula*). Meanwhile, potential biological control agents identified in the Tupi and Polomolok were spiders, lady bugs, praying mantis and earwigs. Spiders specifically were found in great abundance in these two sites. Praying mantis and lady bugs are also potential biocontrol agents for aphids, scale insects, mealy bugs and/or their eggs [10]. As for earwigs, there are contentious claims about whether they are beneficial or not. On the one hand, they eat insects that infest banana foliage. On the other hand, they also eat the foliage though it would take a large population to do considerable damage. Finally, aromatic plants such as *Calendula officinalis* (marigold) and *Cymbopogon nardus* (citronella grass) were also planted by farmers along the borders of the banana fields to repel destructive insects.

4. Discussion

In the Philippines, there is scanty literature reporting about pest management from the perspective of banana farmers who are the stakeholders in this particular enterprise. Until this study, no attempt had been made to document the many aspects of farmers' knowledge in Southern Mindanao especially in relation to their views and perceptions about integrated pest management. Current information available is mostly anecdotal and does not provide quantitative data from which legislative policies, NGO action and researches can be based and through which funds can be sourced out. This study therefore aimed to fill in this knowledge gap so that financial assistance and technology/information transfer will be extended to this long marginalized agricultural sector.

In this study, male farmers outnumbered their female counterparts though no gender disparity was noted in terms of task assignments for all four sites. In terms of age, education and farming experience, notable variation was noticed in all farmers. Inquiries about insect problems encountered in the farms revealed that the banana plants were infested by similar major pests.

The banana farms in Katangawan and Lun Padidu were planted with *Cardava* banana variety which is very robust, thrives well and produces yield with minimal care and zero inputs. On the other hand, the Polomolok and Tupi farms were planted with *Lakatan* and *Bungolan* varieties respectively. These are highly susceptible varieties which incidentally harbored the largest assemblage of field pests. Diverse traditional control methods were therefore employed by banana farmers to tackle pest problems in these areas. Foremost of these is the use of botanical fertilizers and pesticides. Touted as the ideal solution to the pest problem, botanical pesticides are reported to exhibit a broad spectrum of activity, are easy to process and use, have short residual activity and therefore do not persist in the environment and fatty tissues of animals [11]. On the downside, these botanical formulations take a lot of time and effort to prepare and are difficult to use in a plantation setting. Another traditional control technique is the use of insect repelling plants such as *Calendula officinalis* and *Cymbopogon nardus*. These plants are readily available in the farms, environmentally benign and a low costing yet highly efficacious alternative to synthetic pesticides.

Conversely, farmers were divided in their opinions about the effectiveness of IPM. Some farmers disclosed that the purely organic approach worked in their fields while others believed that it has fallen short of bringing down pest numbers and increasing productivity in banana farms. Many farmers are therefore more inclined to shift to pesticide use because of the perceived effectiveness of the latter.

5. Conclusion

Even the most studied theoretically drafted strategies to control pest populations are bound to fail unless farmers, who are the major stakeholders, are involved every step of the way. The strong points of farmers' knowledge stem from their long and intimate association with the crop, their unlimited opportunities for observation during the whole cropping season and their comprehension of pest-crop dynamics within the agro-ecological landscape. By engaging them and enlisting their help, a pest management strategy that is sustainable, safe and cost-effective can be designed and implemented.

On the other hand, on-farm trials are needed to evaluate the efficacy of these botanicals and to determine their mode of action against insect pathogens. If such trials are undertaken, there will be documentation of the specific action of these botanical formulations and suggestions about the time, frequency of application as well as the effective dosage. Phytochemical screening should also be done to detect bioactive compounds in the botanical preparations and to determine the minimum effective concentration that is lethal to pathogens. Finally, economic viability analysis should be carried out to accurately quantify the effects of IPM on yield and overall productivity in the banana farms.

6. Acknowledgments

The authors would like to convey their most profound gratitude to the Commission on Higher Education (CHED-ZRC), Governor Miguel Rene Dominguez, Prof. Carmen Nisperos, Mr. Fernando Montemayor, Eduardo Sandulan Jr. and Bebot Decolongon for providing assistance in various forms. Heartfelt thanks are

also due to all participating banana farmers for taking time out from work in the fields to help the research team. Their involvement is the focal point in this research endeavour.

7. References

[1] A. Srangsam and K. Kanchanapoom. Thidiazuron-induced plant regeneration in callus culture of triploid banana (Musa sp.) 'Gros Michel', AAA group. J*ournal of Science and Technology*. 2003. **25** (6): 689-696.

[2] F. S. Dela Cruz, *et al*. Farmers' Handbook on Introduced and Local Banana Cultivars in the Philippines. Bioversity International. 2008

[3] B. Bathan and F. Lantican. Factors Affecting Yield Performance of Banana Farms in Oriental Mindoro. *J. ISSAAS*. 2010. **16** (1): 110-120.

[4] K.V. Sushu Reddy, L. Ngode, J.W. Ssenyonga, M. Wabule, M. Onyango, T.O. Adede and S. Ngoze. 1998. Management of pests and Diseases of banana in Kenya: A status report. Mobilizing IPM for sustainable banana production in Africa: Proceedings of a workshop on banana IPM, Nelspruit, South Africa, pp. 23-28 November 1998.

[5] W. J. Sutherland. *Ecological Census Techniques: A Handbook*. 2nd ed. Cambridge University Press. United Kingdom. 2006

[6] A. L. Deng, J. O. Ogendo, G. Owour, P. K. Bett, E. O. Omolo, M. Mugisha-Kamatenesi and J. M. Mihale. Factors determining the use of botanical insect pest control methods by smallholder farmers in the Lake Victoria basin, Kenya. *African Journal of Environmental Scinece and Technology*. 2009. **3**(5): 108-115.

[7] S. Tiwari, R. B. Thapa, D. M. Gautam and S. K. Shreshta. Survey of Banana Stem weevil (*Odoiporus longicollis* (OLIV.) (COLEOPTERA : CURCULIONIDAE) in Nepal. *Journal of the Institute of Agriculture and Animal Science*. 2006. **27**: 127-131.

[8] J, Kamanula G.W. Sileshi, S. R. Belmain, P. Sola, B. M. Mvumi, G. C. K. Nyirenda, S. P. Nyirenda and P.C. Stevenson. Farmers' Insect pest management practices and pesticidal plant use in the protection of stored maize and beans in Southern Africa. *International Journal of Pest Management*. 2010. **57** (1): 41-49.

[9] M. Mugisha-Kamatenesi, A.L. Deng, J.O. Ogendo, E.O. Omolo, M. J. Mihale, M. Otim, J. P. Buyungo and P. K. Bett. Indigenous knowledge of field insect pests and their management around lake Victoria basin in Uganda. *African Journal of Environmental Science and Technology*, 2008. **2**(8): 342-348.

[10] McIlveen, Garland, and Charles L. Cole. Undated. Insect Control Guide for Organic Gardeners TAEX Bull. 1252.

[11] Philip G. K. and Robert A. B. Florida Pest Control Association, 1998.