Eco. Env. & Cons. 27 (2) : 2021; pp. (645-649)
Copyright@ EM International
ISSN 0971–765X

Survey and identification of sugarcane insects and their natural enemies in Sa Kaeo Province, Thailand

Janejira Name

Crop Production Technology Program, Department of Agricultural Technology, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani 13180, Thailand

(Received 29 July, 2020; accepted 18 September, 2020)

ABSTRACT

Sugarcane is one of the most important industrial crops in Thailand. The Sa Kaeo province in the east of Thailand is a crucial source for sugarcane production in the country. The information of insect pest identification is signified in the primary step for the pest management. Therefore, this study was focused on the surveillance of sugarcane insect pests and natural enemies in Sa Kaeo. A study on insect Pest diversity was primarily observed duringa field survey on eight districts and conducted in the months of March to November, 2019. The sugarcane insect pests were collected by sweep netting and identified by taxonomic classification. About 31 species of insects belonging to 21 families and 7 orders, were associated with sugarcane crop pest and 11 species comprising 10 families and 5 orders were recovered as natural enemies. The species diversity was in the range of 1.63-2.49 and maximum was revealed in Nong Bon district. The highest species evenness was observed in the field from Khok Pi Kong district (0.59) while, the field of Sa Khwan district was the least (0.34). The Simpson's Index (D) and Simpson's Index of Diversity (1 – D) were highest in the field of Ta Yaek district as 0.12 and 0.88, respectively. The lower of those indices were obtained from Ban Klaeng's field (0.13 and 0.87).

Key words: *Diversity, Sugarcane insect, Natural enemies, Sugarcane field, Sa Kaeo Province*

Introduction

Approximately 80% of global sugar production is derived from sugarcane. Thailand comes at fourth position of worldwide production. Moreover, sugarcane also supports one of the largest agro-processing industries of Thailand. The cultivation area of 13 billion square meters (8,013,000 Rai) are provided for sugarcane cultivation. As of 2018, sugar cane production in Thailand was approximately 8.4 billion metric tons with 12.28 tons/ Rai of sugarcane yield (Centre for Agricultural Information Office of Agricultural Economics, 2019) and contributed almost 94 billion Baht in the export income. The consumption of sugarcane has steadily increased over several years due to the domestic and export demand. The instability of sugarcane yield is markedly influenced by many factors likestrains, climate, environmental stress and prevalence of pests and diseases. Among them, insect pests are known to inflict considerable loss in cane yield as well as sugar output.Sugarcane is knownto be attacked by sugarcane plant hopper (*Perkinsiella saccharicida* Kirkaldy). The *P. saccharicida* is a vector for the virus that causes Fiji disease (FD) and causes red leaf lesions, wilting, and growth reduction(Institute for the Study of Invasive Species, 2014). The damage by sugarcane whitefly (*Aleurolobus barodensis* Muskell) not only decreases the sugar content of sugarcane, but alsocauses leaves to appear pale (Taxonomy

checklist of the world's Whiteflies, 2014). The sugarcane mealybug (*Saccharicoccus sacchari*) feeds by tapping into both the node and cane of sugarcane thus leading to poor growth and low sugarquality (brix and purity) (Plantwise Knowledge Bank, 2014). The survey of insect pests and natural enemies emerged over three-decades. However, the current changes in global climatic regimes, atmospheric carbon dioxide or rainfall distribution directly affects the survival, development, reproduction and dispersal of pest insects. Therefore, the survey information on the diversity and quantity of insect pests is essential for effective prevention of damage to sugarcane and for designing insect management strategies.

Thus, the present study was undertaken with an objective to analyze the status of insect pests and natural enemies in sugarcane crop under climatic conditions by conducting surveys and surveillance in eight districts of Muang prefecture, Sa Kaeo province. This knowledge of insect pest biodiversity has immense value in the pest management strategies and adds knowledge of predator behavior in relation to the reproduction, population and occurrence of the pest and the crops.

Materials and Methods

Insect sampling

The surveys of insect pests and natural enemies were conducted during monthly intervals of March to November (2019) from various farmers's fields in SaKaeo Province, including Ta Kasem distirict, Sa Kaeo district, Sa Kwan district, Nong Bon district, Kok Pi Kong district, Sala Lunduan district, Ban Keng district and Ta Yak district. The preliminary sampling was carried outusing visual observation by simple random sampling method. The samples were collected from three sites (30 sweeps/site) in the tillering period of sugarcane using sweep netting technique by walking in a diagonal line across the paddy. The specimens were collected in vials with preservative-70% ethyl alcohol. The collected specimens were classified and depositedin the Laboratory of Agriculture, Valaya Alongkorn Rajabhat University under the Royal Patronage at Sa Kaeo Campus.

Identification of sugarcane insects and statistical analyses

The insects and natural enemies were classified upon the taxonomy including order, family and species (Heisswolf *et al.*, 2010; Foster and Obenmeyer, 2010). The estimated ratio of sugarcane insects to natural enemies was identified with the help of experts present from other institutes. The diversity index of specimen was measured using the Shannon-Wiener diversity index (Shannon, 1948), species richness and species evenness and species diversity (Kikkawa, 1996) as follows. The quantification of insects was measured, and analyzed the relation viatwo variables factor as physical factor, e.g. temperature, relative humidity and rainfall ratio; and biological factor e.g., major natural enemies.

$$\text{Species diversity } (H') = -\sum_{i=1} pi \log pi$$

Where

$P_i = n_i/N$

n_i= Number of individuals of a species i.

N= Size of whole community.

S= Total number of species.

$$\text{evenness} = H/Hmax$$

where

H = the realized value of diversity andHmax is the maximum possible value of diversity.

Species richness for the two communities,

$$D = S\sqrt{N}$$

Where

S = equals the number of different species represented in your sample

N= equals the total number of individual organisms in the sample

Results and Discussion

Assessment of sugarcane insect pests and natural enemies in Muang, Sa Kaeo province

From the field survey of eight districts in Sa Kaeo province, the specimens were identified into two major groups as sugarcane insect pests and natural enemies, including predators and parasitoids. A total of 31 sugarcane insect pests were obtained and classified into sevenorder as follows: Coleoptera, Hemiptera, Thysanoptera, Lepidoptera, Orthoptera, Odonata and Diptera. The insects of Coleoptera were divided into *Serangium* sp., *Sepiomus* sp., *Dactylotrypes longicollis*, *Hypomeces squamosus* Fabricius, *Dicladispa armigera* (Olivier), *Adoretus*

compressus (Weber), *Anthelephila caeruleipennis*, *Stricticollis longicollis*, *Anthelephila pedestris*, *Callosobruchus maculatus* (F.), *Aulacophora indica*, *Chrysolina coerulans*, *Aspidimorpha* sp. and *Rhyzoperthadom inica* (F.). In the case of Hemiptera, the eight families were investigated as *Cicadulina bipunctata* (Melichar), *Cofana spectra* Distant, *Recilia dorsalis* (Motschulsky), *Nilaparvata lugens*, *Callitetrix versicolor* Fabricius, *Stephanitis typicus*, *Dysdercus cingulatus* Fabricius and *Cletus trigonus*. The species of thrip was observed as *Stenchaetothrips biformis.* Thepea blue butterfly (*Lampidesboeticus*) and Amata (*Amata sperbius* Fabricius) were found and belonged to Lycaenidae and Arctiidae, respectively. The appearance of two genus in Orthoptera were indicated as Tettigonoiidae (*Conocephalus longipennis*) and Acrididae (*Patanga succincta*). The pinhead wisp (*Agriocnemis femina*) was a species of damselfly in the family Coenagrionidae and discovered in this area. Both Agromyzidae and Cecidomyiidaein Diptera were detected and identified tobe a bean fly (*Ophiomyia phaseoli*) and asian rice gall midge (*Orseolia oryzae*).

The eleven types of natural enemies (predators and parasitoids) that were found in this study were classified into 5 orders comprising Coleoptera, Hemiptera, Hymenoptera, Odonata and Araneae. The ladybird (*Micraspis discolor* (Fabricious)) in the genus of Coccinellidae and assassin bug (*Sycanuscollaris*) in the genus of Reduviidae were found. The Hemiptera contained five genus as Chlacididae, Braconidae, Vespidae, Eucharitidae, Trichogrammatidae and Ichneumonidae, and four species as *Dirhinus* sp., *Cotesiaplutellae*, *Aphidius* sp. and *Gauldiana* sp. The insect genus Coenagrionidaeen compassing the dragonfly and Oxyopidae inclosing lynx spider (*Oxyopes javanus*) were encountered.

The detection of sugarcane insects and natural enemies in this study was related to the investigation of Kumarasinghe (1999) that identified insects associated with sugarcane in Sri Lanka. The result indicating that a total of 103 insect species comprising Coleoptera (31 spp.), Dictyoptera (2 spp.), Diptera (5 spp.), Heteroptera (12 spp.), Homoptera (18 spp.), Hymenoptera (7 spp.), Isoptera (3 spp.), Lepidoptera (13 spp.), Orthoptera (9 spp.), and one species each of Thysanoptera, Nuroptera and Trichoptera were recorded. In addition, the collected data demonstrated that a total of 98,423 individuals including 143 species were identified in sugarcane elds of Khon Kaen Province, Thailand and classified into ve functional feeding groups: herbivores, predators, decomposers, parasitoids, and pollinators (Voraphab *et al*., 2015). Moreover, the diversity study of sugarcane insect in Pakistan that provided by Ahmed *et al*. (2004) showed the highest population of sugarcane plant hoppernamely Homoptera (*Pyrilla perpusilla*, *Otinotusoneratus*, *Perkincsiella* sp, *Alerolobus barodenesis*). The varieties of sugarcane insect pests have been identified as Lepidoptera (*Scripopha ganivella*, *Chilo infuscatellus*, *Emmaloceradepressella*, *Acherontia atropos*), grasshoppers (Orthoptera) (*Atractomorpha acutipennis*, *Coenagrion puella*, *Gryllus bimaculatus*, *Trigonidium cicindeloides*, *Chrotogonus trachypterous*, *Oxya*

Table 1. Number of species, number of families and percentage population of insect pest, natural enemies recorded in sugarcane fields at Muang district, Sa Kaeo Province.

No.	Order Insect species	No. of Family	No. of species	Population of percentage (%)
1	Diptera	2	2	1.05
2	Odonata	1	1	1.17
3	Orthoptera	2	2	1.40
4	Lepidoptera	2	2	8.41
5	Thysanoptera	1	2	1.64
6	Hemiptera	6	8	14.60
7	Coleoptera	7	14	71.73
Natural enemies				
1	Coleoptera	1	1	8.97
2	Hemiptera	1	1	0.64
3	Hymenoptera	6	7	51.92
4	Odonata	1	1	1.28
5	Araneae	1	1	37.18

intricata, *Euconocephalus incertus*, *Hedotettix gracilis*, *Chlaenius quadricolor*, *Orthrophagus atroplitus*), Beetles (Coleoptera) (*Calosoma maderae*, *Craspendophorus elegans*, *Orthrophagus atroplitus*, *Scrabaeus brahminus*, *Heteroderes lenis, Aspidomorpha miliaris*, *Aulocophora foveicolis*) and Hymenoptera (*Vespa orientalus*, *Rhyssa persuasoria*, *Formica* Spp., *Monomorium minimum*).

The biodiversity of insect pest associated withsugarcane

For the diversity study, a total of 856 individuals were collected in sugarcane field and categorized into 7 orders and 11 families by the taxonomy classification. The Coleoptera was found to be the most dominating (71.73%) followed by Hemiptera (14.60%) (Table 1). However, the result was conflicting to the previous study of Pedigo (2002) that Lepidoptera was dominant in sugarcane insect pest. Nonetheless, the Lepidoptera was related to the seasonal changes of environmental conditions (Cartea *et al*., 2009).

The identification of sugarcane natural enemies instructed that 156 individuals were captured, corresponding to 5 orders and 10 families, out of which, Hymenoptera was the most abundant in sugarcane fields followed by Coleoptera.

The insect pest biodiversity is important for agricultural ecosystems such as the recycling of nutrients and biological control of pests. For the biodiversity study of sugarcane insect pest, the species diversity and richness of 8 regions in Sa Kaeo Province were analyzed as shown in Table 2. Khok Pi Kong district has the maximum value of Evenness (0.59) with the minimum in Sa Khwan district (0.34). The highest Shannon diversity index (H) was found in the sugarcane field of Nong Bon district (2.49) while the lowest index was found in Ban Klaeng district (1.63). The type of insect pest was correlated to the diversity index. The variety of insect type was also found in the sugarcane field of Nong Bon district. Moreover, the low variation of insects were found in the sample of Ban Klaeng district. The high diversity index may imply to high integrity, sustainability, and biological control of that ecosystem. The majority of identified insects in this study was categorized to insect pest and natural enemy that can control the quantities of insect pest. The detection of both insect pests and natural enemies may specified the low level of pesticide accumulation.

The biodiversity of insect pest was indicated by Simpson' index (D) and Simpson' index of diversity (1-D). The survey crop at Tha Yaek district recorded the highest Simpson' index of diversity (0.88) followed by Ban Klaeng district (0.87). Nevertheless, the diversity of each region Simpson' index wasn't significantly different. These the diversity index reflects a variety types of species in different environmental areas. Proportions of each insect pest fluctuated in the different locations and adaptation (Innocent and Dayana, 2012). The surveillance of insect diversity could be used formonitoring and management of insect dispersal (Berryman, 1981; Odum, 1983; Price, 1997; Huffaker and Rabb, 1984). The result in this study also indicated the balance of insect pests and natural enemies and led to control the effectiveness of natural enemies in pest population. The observation of natural enemies in this study is the model that is necessary for insect control and plant damage (Abrams, 2000; Liss *et al.* 1986; Finklestein and Carson, 1985).

Conclusion

The diversity studies of insect pests and their natu-

Table 2. Diversity of insect pest of sugarcane crops at Muangprefecture, Sa Kaeo province

Sugarcane crops	Evenness (E)	Shannon diversity index (H)	Simpson' index (D)	Simpson index of diversity (1-D)	Total of Insect
Tha Kasem	0.58	2.14	0.35	0.65	41
Tha Yaek	0.39	1.81	0.12	0.88	105
Sa Kaeo	0.42	1.97	0.14	0.86	106
Sa Khwan	0.34	1.63	0.14	0.86	119
Ban Klaeng	0.38	1.86	0.13	0.87	131
Khok Pi Kong	0.59	2.04	0.20	0.80	72
Nong Bon	0.57	2.49	0.24	0.76	79
Sala Lamduan	0.52	2.10	0.23	0.77	54

ral enemies were conducted during March to November (2019) from eight sugarcane fields in SaKaeo province. The total of 42 individuals wereclassified into8 orders of insect pests, encompassing 21 families and 31 species, and 5 ordersof natural enemies, including 10 families and 11 species. The maximum diversity index was recorded in Nong Bon district with 2.49, while the minimum was 1.63 in Sa Khwan district. However, similar trends in response to diversity were found in both districts. The crop field of Sa Khwan district also encountered the lowest species evenness index (0.34). In contrast, to the field of Khok Pi Kong recording the highest species evenness (0.59). The diversity that is indicated by Simpson's Index (D) and Simpson's Index of Diversity (1 – D) were extremely high in Ta Yaek district field with 0.12 and 0.88, respectively. The Ban Klaeng's field was observed as having the lower diversity (0.13 and 0.87). However, it is noteworthy that the diversity wasn't differentin each area.

Acknowledgement

This research was supported by Research and Development Institute, Valaya Alongkorn Rajabhat University under the Royal Patronage (Grant No VJ 04/2562)

References

Abrams, P. A. 2000. The evolution of predator-prey interactions: theory and evidence. *Annual Review of Ecology, Evolution, and Systematics*. 31 : 79-105.

Ahmed, A., Suhail, A., Abdin, Z-ul., Iftikhar, S. and Zahoor, K. Z. 2004. Biodiversity of insects associated with sugarcane crop in Faisalabad. *Pakistan Entomological*. 26 : 65-69.

Berryman, A. A. 1981. *Population Systems: A General Introduction*. Plenum Press, New York. 222 p.

Cartea, M.E., Padilla, G., Vilar, M. and Valesco, P. 2009. Incidence of the major Brassica Pests in Northwestern Spain. *Journal of Economic Entomology*. 102 : 767-773

Centre for Agricultural Information Office of Agricultural Economics. 2019. Thailand Foreign Agricultural Trade Statistics, 2018. http://www.oae.go.th, 4 May 2019.

Finklestein, L. and Carson, E.R. 1985. *Mathematical Modeling of Dynamic Biological Systems*. John Wiley & Sons, New York. 355 p.

Foster, R.E. and Obenmeyer, J.L. 2010. Vegetable Insect Identification. Purdue Extension-E65- W. Purdue University.

Heisswolf, A. Netta, K. and Tero, K. 2010. Expansion of the winter moth outbreak range: no restrictive effects of competition with the resident autumnal moth. *JournalEcological Entomology*. 35 (1) : 45-52.

Huffaker, C.B. and Rabb, R.L. 1984. *Ecological Entomology*. John Wiley & Sons, New York. 844 p.

Innocent, X. and Dayana, M. 2012. Insect diversity of sugarcane fields in Theni district, Tamilnadu, South India. *International Journal of Advanced Life Sciences*. 2: 54-57.

Institute for the Study of Invasive Species. 2014. *Perkinsiella saccharicida* Sugarcane Planthopper. Availbable source: http://www.tsusinvasives.org/database/sugar-hopper.html, 2 January 2014.

Kikkawa, J. 1996. Complexity, Diversity and Stability. In: *Community Ecology: Pattern and Process.* Blackwell Scientific Publication, Melbouren. Pp. 41-65.

Kumarasinghe, N.C. 1999. Insect fauna associated with sugarcane plantations in Sri Lanka Division of Pest Management, Sugarcane Research Institute, Uda Walawe 70190, Sri Lanka.

Liss, W. J., Gut, L. J., Westigard, P. H. and Warren, C. E. 1986. Perspectives on arthropod community structure, organization, and development in agricultural crops. *Annual Review of Entomology*. 31: 455-478.

Odum, H. T. 1983. *Systems Ecology*. John Wiley & Sons, New York. 510 p.

Pedigo, P.L. 2002. *Entomology and Pest Management*, 4th edition. pp. 246-247.

Plantwise Knowledge Bank. 2014. Grey sugarcane mealybug (*Saccharicoccus sacchari*) Host plants / species affected. Availbable source: http://www.plantwise.org/Knowledge Bank/Datasheet.aspx?dsid=45090, 2 January 2014.

Price, P. P. 1997. *Insect Ecology*. John Wiley & Sons, New York. 874 p.

Voraphab, I., Hanboonsong, Y., Kobori, Y., Ikeda, H., and Osawa, T. 2015. Insect species recorded in sugarcane fields of Khon Kaen Province, Thailand, over three seasons in 2012. *Ecological Research*. 30(3): 415–415.

Shannon, C.E. 1948. A mathematical theoryof communication. *Bell System Tech. J.* 27 : 37-423, 623-656.

Taxonomy checklist of the world's Whiteflies, 2014. AleurolobusbarodensisMuskell Host plant. Availbable source: http://www.hemipteradatabases.org/whiteflies/?db= aleurodes&lang=en&card=plants, 2 January 2014.