Diversity of Arthropods in Sweet Corn

**Sangkhae Nawanich[1]*, Wiboon Chongrattanameteekul[2]
and Pojjanee Supamongkol[1]**

ABSTRACT

An experiment on the diversity of arthropods was carried out at the National Corn and Sorghum Research Center to determine the diversity and abundance of arthropods in two growing seasons of sweet corn, during June-October 2008. Sampling data was recorded by a visual count method and a sample of 210 plants was observed by a stratified random sampling technique. The type and number of arthropods were recorded at 7, 14, 24, 31, 39, 45, 53 and 63 d after emergence. Diversity of arthropods was analyzed by the Shannon-Wiener diversity index. The results revealed that in the rainy season, 43 types of arthropod were found and 32 types were found in the late-rainy season. The diversity indices ranged from 0.5956 to 2.7013, with the highest value ($H' = 2.7013$) at 31 d after emergence in the rainy season. However, in the late-rainy season the diversity indices ranged from 0.2656 to 1.0908, with the highest value ($H' = 1.0908$) at 14 d after emergence. In addition, insects in the Aphididae family made up the largest fraction of arthropods found in the rainy and late–rainy seasons with 4,216 and 39,199, respectively. Therefore, the rainy season had the higher diversity index and type accumulation than the late-rainy season, while the number of individuals was higher in the late-rainy season.
Keywords: sweet corn, diversity index, arthropod

INTRODUCTION

Sweet corn has become a popular cash crop in Thailand, especially hybrid varieties with high yield and quality that can be grown throughout the year. This situation provides important food and propagation sources for insect pests, resulting in increased infestation potential and leading to serious crop damage. Previously, 25 families and 76 species have been reported as insect pests of corn in Thailand (Areekul *et al*., 1966). Sweet corn insects were classified into four groups based on the quantity and damage caused by the insects: 1) key pests 2) potential pests 3) natural enemies and 4) minor pests (Nawanich *et al*., 2004). The abundance of insects varied from time to time according to natural and physical factors, such as season, humidity, rainfall, temperature, surrounding crop and agronomic practices. Species diversity and complexity of association among species are essential to the stability of the community. Moreover, understanding species diversity and abundance at various times is fundamental for pest control. The objective of this study was to determine the arthropod diversity and seasonal abundance on the sweet corn "Insee 2" single cross, hybrid variety in two different cropping periods.

MATERIALS AND METHODS

The experiment was conducted at the National Corn and Sorghum Research Center (NCSRC), Pakchong, Nakhon Ratchasima, Thailand, during two growing seasons, from June to August 2008 (rainy season) and from August to October 2008 (late-rainy season). The plot size in the experimental field was 1,312.5 m². "Insee 2" sweet corn seeds were planted with a spacing of 0.25 × 0.75 m. Agronomical practices commonly used for sweet corn production were employed in this experiment. Sampling was conducted by a visual count method, with a sample of 210 plants observed by a stratified random sampling technique. The numbers and types of insects were recorded at 7, 14, 24, 31, 39, 45, 53 and 63 d after emergence (DAE). Diversity of insects found in sweet corn was analyzed by the Shannon-Wiener diversity index (Burikam, 1990) using Equation 1:

$$H' = \sum_{i=1}^{s} p_i \ln p_i \qquad (1)$$

where: H' = index of species diversity

S = the total number of species

p_i = the proportion of the ith species in the community

ln = natural logarithm

RESULTS AND DISCUSSION

In the rainy season, 43 arthropod types were found. The highest arthropod diversity (H' = 2.7013) was found at 31 DAE. Arthropods in sweet corn exhibited the highest number of types (31) at 39 DAE, with the greatest overall abundance of 3,388 individuals at the same age and based on the diversity index, there was the least arthropod diversity (H' = 0.5956). This result may have been due to the low proportion of the total number of individuals of each type (Table 1).

In the late-rainy season, 32 arthropods types were found. The highest arthropod diversity (H' = 1.0908) was found at 14 DAE. At 45 DAE, the least diversity (H' = 0.2656) was observed, while at the same time there was the highest number of types (23) and the greatest overall abundance with 30,717 individuals (Table 2). This result may have been due to the low proportion of the total number of individuals of each species.

Comparing the two seasons, it was found that the type accumulation and type abundance on sweet corn were 39 and 3,388 in the rainy season and 414 and 30,717 in the late-rainy season, respectively (Tables 1 and 2), indicating that type abundance in the late-rainy season was higher than in the rainy season, while the rainy season exhibited more diversity than the late-rainy season.

Table 1 Type richness, abundance and diversity indices of arthropods in sweet corn for 8 weeks at NCSRC, Nakhon Ratchasima province during rainy season (June–August, 2008).

Days after emergence	Types richness[1]	Types accumulation[2]	Types abundance[3]	Diversity indices[4]
7	11	11	39	2.1656
14	14	17	59	1.9138
24	19	26	300	2.3909
31	25	33	243	2.7013
39	31	39	3,388	0.5956
45	25	41	1,295	1.4430
53	24	42	1,185	1.9526
63	18	43	603	1.5897

1/ Number of types   2/ Accumulation number of types

3/ Number of individuals   4/ Shannon – Weiner diversity index (H')

Table 2 Type richness, abundance and diversity indices of arthropods in sweet corn for 8 weeks at NCSRC, Nakhon Ratchasima province during late-rainy season (August-October, 2008).

Days after emergence	Types richness[1]	Types accumulation[2]	Types abundance[3]	Diversity indices[4]
7	6	6	414	0.7086
14	14	14	1,047	1.0908
24	18	21	891	0.7240
31	22	28	1,300	0.7706
39	21	29	3,526	0.3873
45	23	30	30,717	0.2656
53	19	31	8,719	1.0165
63	16	32	1,753	0.8460

1/ Number of types   2/ Accumulation number of types
3/ Number of individuals   4/ Shannon – Weiner diversity index (H)

In this study, the types of pests and natural enemies were ranked in accordance with their abundance. There were 27 types of pests from the rainy season and 18 from the late-rainy season. Only four types were dominant. In the rainy season, the Aphididae made up the largest fraction of pests found, followed by the Thripidae, Pyralidae: (*Ostrinia furnacalis* Guenee) and Nitidulidae, respectively. In the late-rainy season, there was the same dominance of four pest families as in the rainy season, but the Pyralidae were in the fourth position (Table 3). However, the Aphididae appeared with the highest number at 39 DAE and declined at 45 DAE in the rainy season (Figure 1(a)). In the late-rainy season, they emerged rapidly at 45 DAE. It was noticeable that these periods coincided with the flowering stage of the two crops (Figure 1 (b)). Members of the Aphididae were a serious key pest source in the sweet corn crops. In addition, in the late-rainy season, the Aphididae constituted a more serious pest source than in the rainy season, while other the three pest groups required watching closely with regard to crop protection.

Natural pest enemies, such as insect predators, insect parasitoids and spiders, play an important role in insect pest control. In this study, 16 and 18 natural enemies were found in the rainy season and the late-rainy season, respectively (Table 3). The four dominant families were Chelisochidae: *Proreus simulans* Stallen, Spiders, Anthicidae and Coccinellidae: *Menochilus sexmaculata*. The Chelisochidae had their greatest numbers when the Aphididae population increased in both crops and the populations were highest at the end of each season (Table 3 and Figure 2). Patanakamjorn (1978) reported that Chelisochidae: *Proreus simulans* Stallen occurred in corn fields throughout the year at the National Corn and Sorghum Research Center. In the light of evidence of an increase in populations of the corn leaf aphid, there seemed to be an increase in Chelisochidae populations as well, with the latter consuming more than one pest, such as egg and larvae of the Asian corn borer (Patanakamjorn *et al*., 1978; Nawanich *et al*., 2008). Populations of the other three dominant families of predators rose to peaks during the middle of the season, when the Aphididae increased. In addition, these could consume serious pests of sweet corn, such as aphids, small insect and the eggs of Lepidoptera.

CONCLUSION

In the rainy season, 43 types of arthropod were found and 32 types were found in the late-

Table 3 Total numbers of arthropod types in sweet corn and their abundance collected by visual count eight times in rainy and late-rainy season 2008.

Groups	Types	Types abundance	
		Rainy season	Late-rainy season
Pests	Aphididae	4,216	39,199
	Thripidae	634	5,198
	Pyralidae: *Ostrinia furnacalis* Guenee	400	316
	Nitidulidae	109	439
	Miridae	196	3
	Chrysomelidae: *Aulacophora similis* Olivier	106	22
	Cicadellidae: *Cicadulina bipunctata* Melichar	105	47
	Colobathristidae	44	30
	Cicadellidae: *Balclutha* sp.	44	25
	Chrysomelidae: *Monolepta signata* Olivier	34	15
	Derbidae	28	13
	Geometridae	19	0
	Curculionidae: *Hypomeces* sp.	17	21
	Acrididae	16	0
	Lymantiidae	6	3
	Noctuidae: *Spodoptera litura*	4	0
	Scarabaeidae: *Adoretus compressus*	4	0
	Noctuidae: *Mythimna separata*	3	1
	Noctuidae: *Helicoverpa armigera*	3	0
	Scutelleridae	3	0
	Gryllidae: long horned grasshopper	3	0
	Geometridae	2	7
	Chrysomelidae:*Phyllotreta chontanica*	2	4
	Curculionidae:*Calomycterus* sp.	2	0
	Hispidae	1	4
	Elasteridae	1	0
	Pentatomidae:*Nezara viridula*	1	0
	Pyralidae:*Cnaphalocrosis medinalis* (Guenee)	0	3
	Isoptera	0	1
	Total	6,003	45,351
Natural enemies	Chelisochidae:*Proreus simulans* Stallen	558	2,383
	Spider	214	288
	Anthicidae	118	143
	Coccinellidae:*Menochilus sexmaculata*	80	107
	Gryllidae:*Oecanthus* sp.	38	15
	Geocoridae	37	42
	Coccinellidae:*Micraspis discolor*	21	9
	Syrphidae	14	0
	Trichogrammatidae	5	15
	Chrysopidae	5	7
	Coccinellidae:*Harmonia octomaculata*	5	0
	Gryllidae:*Metioche* sp.	4	5
	Dolochopodidae	4	0
	Tachinidae	3	0
	Reduviidae	2	3
	Stephylinidae	1	0
	Anthocoridae	0	2
	Hemerobiidae	0	1
	Total	1,109	3,020

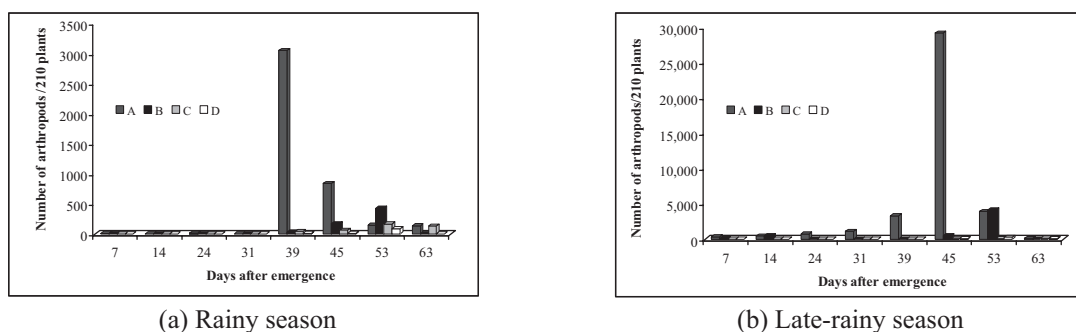(a) Rainy season
(b) Late-rainy season

Figure 1 The most abundant pests found in (a) rainy; and (b) late-rainy season. (A = Aphididae; B = Thripidae; C = Pyralidae: *O. furnacalis;* and D = Nitidulidae.)
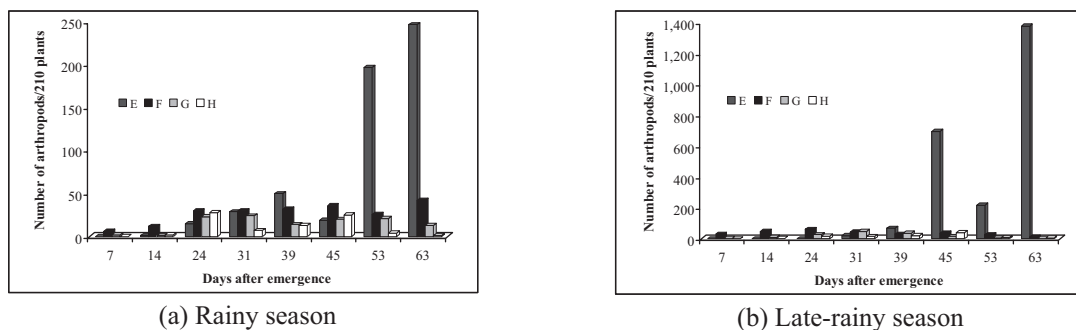

(a) Rainy season
(b) Late-rainy season

Figure 2 The most abundant natural enemies found in (a) rainy; and (b) late-rainy season. (E = Chelisochidae; F = Spiders; G = Anthicidae; and H = Coccinellidae: *M. sexmaculata*.)

rainy season. The diversity indices ranged from 0.5956 to 2.7013, with the highest ($H' = 2.7013$) at 31 days after emergence in the rainy season. However, in the late-rainy season, the diversity indices ranged from 0.2656 to 1.0908, with the highest ($H' = 1.0908$) at 14 days after emergence. In addition, insects in the Aphididae family made up the largest fraction of arthropods found in the rainy and late-rainy seasons, with 4,216 and 39,199, respectively. Therefore, the rainy season had a higher diversity index and type accumulation than the late-rainy season, while the number of individuals was higher in the late-rainy season.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the

LITERATURE CITED

Areekul, S., B. Wanleelag, A. Wattanathanyakam, U. Sakulpanich, O. Prachuabmoh, P. Tiraweth and Y. Singhasenee. 1966. **Insect Pests of Corn in Thailand.** 9th Technical Document. Department of Entomology and Plant Pathology, Kasetsart University, Bangkok.

Burikam, I. 1990. **Ecological Analysis Referring to the Study of Insects.** Kasetsart University. Kamphaeng Sean, Nakhon Pathom. 108 pp.

Nawanich, S., S. Jamornmarn, A. Saimaneera and P. Jangpon. 2004. Sweet corn diversity in pest management. pp. 327 - 333. *In* **Proceedings of The 32nd National Corn and Sorghum Research Conference.** July 13-15, 2004. Sukothai.

Nawanich, S., W. Chongrattanameteekul, P. Supornpath and S. Jamornmarn. 2008. Population dynamics, biology and effects of selected insecticides on earwig, *Proreus simulans* Stallen (Dermaptera: Cheliso-chidae), an important predator in sweet corn. pp. 249 - 257. *In* **Proceeding of the 3rd workshop of Kasetsart University Corn and Sorghum Research Project.** May 14 - 16, 2008. Phet Chabun.

Patanakamjorn, S., W.D. Guthrie and W.R. Young. 1978. *Proreus simulans*: an earwig predator of the tropical corn borer, *Ostrinia furnacalis*. **Iowa State Journal of Research** 52: 277-282.