NATURAL ENEMIES OF THE FALL ARMYWORM *SPODOPTERA FRUGIPERDA* (LEPIDOPTERA: NOCTUIDAE) IN COAHUILA, MÉXICO

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The fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith) is the main insect pest of corn and other crops in Latin America (Hernández-Mendoza et al. 2008). The larvae cause severe damage in all phenological stages of the plant (Villa-Castoreña & Catalan-Valencia 2004). Control has been with synthetic pesticides; however, this method is inefficient and causes chronic poisoning to growers in México due to incorrect use (Tinoco & Halperin 1998). This has led to the search of other options to manage *S. frugiperda* including use of natural enemies. Twenty two species of natural enemies have been reported in various parts of México (Molina-Ochoa et al. 2004). Our objectives were to identify the natural enemies of the FAW and the level of parasitism in the area of Buenavista, Coahuila, México.

Twelve weekly samplings of FAW larvae were made from Jul to Sep in corn fields infested with FAW at the "El Bajio" Experimental Station of the Universidad Autónoma Agraria Antonio Narro (25°23'N, 101°00'W). On each sampling date, 100 larvae of each of the first 3 instars, were randomly collected and placed in 1-oz. (29.6 mL) plastic cups containing an artificial diet (Southland Products Incorporated) and incubated in a bioclimatic chamber at 25 ± 2°C, a photoperiod of 12:12 L:D h, and 50-60% RH. Parasitoids were recovered, tagged, and preserved in 70% alcohol for further mounting and identification with taxonomic keys (Triplehorn & Johnson 2005). Confirmations of identifications were made by Dr. Alejandro González Hernández (Departamento de Ciencias Biológicas, Universidad de Nuevo León, San Nicolás de los Garza, Nuevo León, México).

Entomopathogenic fungi from dead larvae were cultured in moist chambers and purified in an artificial medium of potato dextrose agar (PDA) complemented with corn liquor for *Beauveria bassiana* (Balsamo) Vuilleiman and V8-Agar for *Nomuraea rileyi* Farlow (Samson), at a pH of 6.0. The purified entomopathogens *N. rileyi* and *B. bassiana* were identified according to their microscopic and macroscopic characteristics (Barnett 1986).

Larvae with symptoms of viral infection were processed by taking samples of occlusion bodies (OBs) and dying the preparations with 0.4% Giemsa stain. Identification was made at the Parasitology Dept., based on the OBs that showed polyhedric characteristics of the nucleopolyhedrovirus group (NPV).

Parasitism (as a percentage) was calculated based on the total number of larvae of *S. frugiperda* that were positive for parasitoids and entomopathogens divided by the total number of FAW larvae collected.

Altogether, 1200 larvae of *S. frugiperda* were collected. Parasitoids and parasites such as Hymenoptera (Ichneumonidae, Braconidae, Eulophidae) and Diptera (Tachinidae), as well as entomopathogens (Nucleopolyhedrovirus, *N. rileyi* and *B. bassiana*) killed 526 larvae (43.83%). Sixty-eight (5.7%) died from unknown causes and the remainder of the larvae (674) reached adulthood (Table 1). Mortality of some parasitoids (132, 11% of the total) occurred before emergence of the adults.

Parasitoids caused 35.25% parasitism of the larvae (Table 1). Armenta et al. (2008) reported a parasitism rate of 32.2% for Sonora, México. Braconidae was the best represented with 261 specimens (21.75% of total parasitism), in which 257 were *Chelonus insularis* (21.42%), *Ch. cautus* (0.25%) and *Ch. sonorensis* (0.08%) (Table 2). Molina-Ochoa et al. (2004) reported similar percent of parasitism in Michoacán Mexico (45.3%).

Ichneumonidae showed low levels of parasitism (1.17%). This information is similar to that reported by Murúa et al. (2006). *Pristomerus* sp. presented a low level of parasitism (0.42%), similar to the 0.24% reported by Ruíz-Nájera et al. (2007) (Table 2). *Chelonus sonorensis* showed a parasitism level of 0.75%, contrasting with data from Cruz-Sosa (2007), who found it to be the most abundant species in Oaxaca, México. *Euplectrus plathyphenae* (Eulophidae) showed 0.42% parasitism. Only 0.92% parasitism by tachinid flies was found in the present study. Mortalities caused by the entomopathogens, NPV, *N. rileyi*, and *B. bassiana* were of 2.0, 0.75 and 0.08%, respectively (Table 2).

Summary

Larvae of the first 3 instars of the fall armyworm (FAW) *Spodoptera frugiperda* (J.E. Smith)

TABLE 1. PERCENTAGE OF PARASITISM OF NATURAL ENEMIES OF *SPODOPTERA FRUGIPERDA* LARVAE FOUND IN CORN LANDRACES IN BUENAVISTA, COAHUILA, 2009.

				Entomopathogens			
Date (Month and day)*	Parasitized larvae	Parasitoids emerged	% of parasitism by date	NPV	*N. rileyi*	*B. bassiana*	Died from unknown causes
08-Jul	6	6	6	1	0	0	0
15-Jul	33	18	33	4	0	0	8
22-Jul	29	18	29	3	0	0	12
29-Jul	56	43	56	0	0	0	13
05-Aug	51	26	51	4	0	0	11
12-Aug	69	29	69	2	2	0	5
19-Aug	35	30	35	2	0	0	2
26-Aug	32	28	32	1	1	0	0
02-Sep	24	19	24	1	0	1	2
09-Sep	31	30	31	0	0	0	0
16-Sep	30	21	30	3	5	1	13
25-Sep	27	23	27	3	1	0	2
Total	423	291	35.25	24	9	2	68

NPV = Nucleopolyhedrovirus.
*In each sampling date 100 total larvae were randomly collected.

TABLE 2. NATURAL ENEMIES OF *SPODOPTERA FRUGIPERDA* LARVAE FOUND IN CORN LANDRACES IN BUENAVISTA, SALTILLO, COAHUILA, 2009.

	Jul				Aug				Sep					
Natural enemies	8	15	22	29	5	12	19	26	2	9	16	25	Total	% Parasitism
Hymenoptera														
Braconidae														
Chelonus insularis	0	8	7	39	17	26	19	13	38	29	26	35	257	21.42
Chelonus cautus	1	0	0	0	0	0	2	0	0	0	0	0	3	0.25
Chelonus sonorensi	1	0	0	0	0	0	0	0	0	0	0	0	1	0.08
Ichneumonidae														
Campoletis sonorensis	0	0	0	1	0	3	0	0	5	0	0	0	9	0.75
Pristomerus sp.	0	1	0	0	0	2	0	0	1	0	0	1	5	0.42
Eulophidae														
Euplectrus plathyphenae	0	0	2	0	0	0	1	0	0	2	0	0	5	0.42
Diptera														
Tachinidae														
Archytas marmoratus	0	5	6	0	0	0	0	0	0	0	0	0	11	0.92
Entomopathogens														
Nomuraea rileyi	0	0	0	0	0	2	0	1	0	0	5	1	9	0.75
Beauveria bassiana	0	0	0	0	0	0	0	0	1	0	1	0	2	0.16
NPV	1	4	3	0	4	2	2	1	1	0	3	3	24	2.00
Total	3	18	18	40	21	35	24	15	46	31	35	40	326	27.17

were collected in corn landraces in Buenavista, Coahuila, México, in 2009. A total of 1,200 larvae of FAW were examined in search for biological control agents. Two species of Hyphomycetes entomopathogenic fungi (*Beauveria bassiana* (Balsamo) Vuilleimin and *Nomuraea rileyi* (Farlow) (Samson) and 1 nucleopolyhedrovirus (Baculoviridae) were found. Three species of Braconidae, 2 species of Ichneumonidae, 1 species of Eulophidae, and 1 species of Tachinidae were recovered from FAW larvae.

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Referenced Cited

Armenta-Cárdenas, I., Cortez, M. E., Colín, A. M. M., Pérez, M. J., and Bahena, J. F. 2008. Reporte preliminar de parasitoides asociados a gusano cogollero *Spodoptera frugiperda* J. E. Smith en el sur de Sonora, México, pp. 80-83 *En* Memorias del XXXI Congreso Nacional de Control Biológico. Soc. Mex. Contr. Biol. Noviembre 17-21, 2008. Zacatecas, Zacatecas, México.

Barnett, G. J., and Hunter, B. B. 1986. Illustrated genera of imperfect fungi. Fourth edition. McMillan Publishing Company. USA, 218 pp.

Cruz-Sosa, E., Martínez, L. M., Jarquín, R. L., and Pérez, N. P. 2007. Parasitismo del gusano cogollero del maíz, *Spodoptera frugiperda* Smith (Lepidoptera: Noctuidae), en Oaxaca, México, pp. 70-73 *En* Memorias del XXX Congreso Nacional de Control Biológico- Simposio del IOBC. Soc. Mex. Contr. Biol. Noviembre 2007. Mérida, Yucatán.

Hernández-Mendoza, J. L., López-Barbosa, E. C., Garza-González, E., and Pérez, M. N. 2008. Spatial distribution of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) in maize landraces grown in Colima, México. Int. J. Trop. Insect Sci. 28: 126-129.

Molina-Ochoa, J., Carpenter, J. E., Lezama-Gutierrez, R., Foster J. E., González-Ramírez, M., Ángel-Sahagún, C. A., and Farías-Larios J. 2004. Natural distribution of hymenopteran parasitoids of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) larvae in México. Florida Entomol. 87: 461-472.

Murúa, G., Molina-Ochoa, J., and Coviella, C. 2006. Population dynamics of the fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae) and its hymenopteran parasitoids in Northwestern Argentina. Florida Entomol. 89: 175-182.

Ruíz-Nájera, R. E., Molina-O. J., Carpenter, J. E., Espinosa, M. J. A., Ruíz, N. J. A., Lezama, G. R., and Foster, J. E. 2007. Survey for hymenopteran and dipteran parasitoids of the fall armyworm (Lepidoptera: Noctuidae) in Chiapas, México. J. Agric. Urban Entomol. 24(1): 35-42.

Tinoco, R., and Halperin, D. 1998. Poverty, production and health: inhibition of erythrocyte cholinesterase through occupational exposure to organophosphate insecticides in Chiapas, México. Arch. Environ. Health. 53: 29-35.

Triplehorn, C. A., and Johnson, N. F. 2005. Study of Insects. 7th Edition. Thompson Brooks/Cole. USA. 864 pp.

Villa-Castoreña, Ma. M., and Catalán-Valencia, E. A. 2004. Determinación de estadios larvales de *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) para la construcción de un modelo de predicción. Folia Entomol. Mex. 43: 307-312.