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# Larval Competition between *Helicoverpa zea* and *Spodoptera frugiperda* (Lepidoptera: Noctuidae) on Corn Ears in Northern México[1]

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J. Entomol. Sci. 47(2): 185-187 (April 2012)

**Key Words** corn earworm, fall armyworm, interspecific association, niche overlap

The fall armyworm, *Spodoptera frugiperda* (J. E. Smith), and the corn earworm, *Helicoverpa zea* Boddie, are the most important insect pests of corn in the southeastern U.S., México, Central and South America (Fuentes et al. 1998, Agron. Mesoam. 9: 42 - 52). The most common feeding site for *S. frugiperda* is the whorl in young plants; whereas, *H. zea* prefer to feed from ears. However, both insect pests can infest and damage either the whorl or the ear, depending on insect development and plant phenology (Chilcutt et al. 2006, J. Econ. Entomol. 99: 2164 - 2170). Feeding from ears by both species is important because of direct grain loss, quality decrease, and facilitation of mycotoxin-producing fungi invasion (Dowd 2003, J. Toxicol. Toxin Rev. 22: 327 - 350).

Despite the frequent cooccurrence of *H. zea* and *S. frugiperda* on corn ears (Rodríguez-del-Bosque et al. 2010, Southwest. Entomol. 35: 157 - 164), there is a paucity on information regarding their interspecific association. Larval densities of both species are usually reduced to one per plant when larvae feed in close proximity due to cannibalism, which may account for up to 75% of larval mortality (Stinner et al. 1977, Can. Entomol. 109: 879 - 890). Similarly, both *H. zea* and *S. frugiperda* prey upon each other and other lepidopterans when competing for space and food (Dorhout and Rice 2010, J. Econ. Entomol. 103: 54 - 62). The objective of this study was to determine the interspecific association between *H. zea* and *S. frugiperda* larvae on corn ears in northern México.

This study was conducted at the Campo Experimental INIFAP (Mexican Agricultural Research Service), near Río Bravo, Tamaulipas (25°57´N, 98°01´W) during the spring growing seasons of 2006 - 2009. Field corn (cv. H-439) was planted each year in 0.5 ha during early February. No insecticides were applied, and other agronomic practices were according to local recommendations. A total of 400 plants was

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**Table 1. Incidence of damaged ears, density, relative % of *H. zea* and *S. frugiperda*, and their interspecific association. Río Bravo, Tam., México. 2006 - 2009.**

| Year | % Incidence | Larvae/ear | Relative % | | Interspecific association | | |
|---|---|---|---|---|---|---|---|
| | | | *H. zea* | *S. frugiperda* | $\chi 2$ | *P* | Phi |
| 2006 | 73.3 | 1.08 | 89 | 11 | 9.2 | < 0.01 | –0.20 |
| 2007 | 38.3 | 0.39 | 90 | 10 | 2.3 | N.S. | — |
| 2008 | 86.2 | 1.15 | 86 | 14 | 69.0 | < 0.01 | –0.39 |
| 2009 | 87.0 | 1.07 | 92 | 8 | 64.5 | < 0.01 | –0.36 |

randomly sampled at milk-dough stage within a week during early-mid May each year. Ears were inspected for *H. zea* and *S. frugiperda* larvae in each of 3 sections: tip, center, and bottom, which approximately represented each a third of the length of the ear. The few larvae, mainly midsized, found at the silk channel were grouped into the tip section. Interspecific association was tested each year by 2 × 2 contingency tables ($\chi^2$, $P < 0.01$), and, if significant, then phi-coefficient of association was calculated (Southwood 1978, Ecological Methods, Chapman & Hall, NY).

Regardless of insect species, >90% of larvae were large (instars 5 - 6), and the remaining were midsized larvae (instars 3 - 4). Incidence of damaged ears and larval density was lowest in 2007 and higher in 2006, 2008 and 2009 (Table 1). The unusually low damage and larval density for this region in 2007 probably was a result of the freezing temperatures on 5 March, which apparently affected the overwintering populations (Rodríguez-del-Bosque 1996, Southwest. Entomol. 21: 209 - 211). Regardless of year, *H. zea* comprised >85% of all larvae (Table1).

Interspecific association between *H. zea* and *S. frugiperda* was negative in 3 of the 4 years, with a maximum phi value of -0.39 in 2008 (Table 1). The negative association, interpreted as repulsion or competence, was clearly influenced by the higher insect density in those 3 years. Competence is derived from niche overlap as both

**Table 2. Relative proportions of *H. zea* and *S. frugiperda* in different ear sections and overlapping probability when both species cooccur in the same section or whole ear. Pooled data (2006 - 2009). Río Bravo, Tam., México.**

| Ear section | *n* | | Relative proportion | | Overlapping probability |
|---|---|---|---|---|---|
| | *H. zea* | *S. frugiperda* | *H. zea* (A) | *S. frugiperda* (B) | (A x B) |
| Tip | 1297 | 149 | 0.987 | 0.917 | 0.905 |
| Center | 16 | 9 | 0.012 | 0.058 | 0.001 |
| Bottom | 1 | 4 | 0.001 | 0.025 | 0.000 |
| Total | 1314 | 162 | 1.000 | 1.000 | 0.906 |

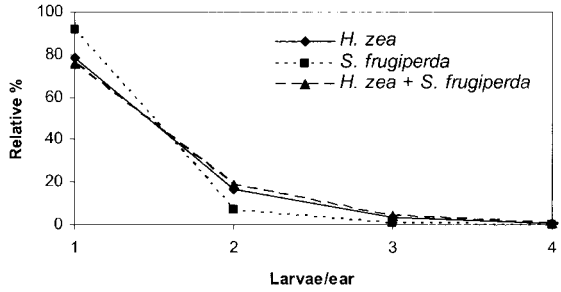


**Fig. 1. Relative % of either *H. zea*, *S. frugiperda*, and *H. zea* + *S. frugiperda* in corn ears. Pooled data (2006 - 2009). Río Bravo, Tam., México.**

species feed from the same resource (ears). Interference between species produces occasional exclusion (Schluter 1984, Ecology 65: 998 - 1005). Further, competition was enhanced by the high probability of cooccurrence in the same section within the ear (Table 2). Both species preferred the tip with a relative proportion of >0.91, which results in an overlapping probability of 90.5% in the tip. Conversely, The probability of intra and intercompetition in the center and bottom of the ear is practically nil. The generalized perception that *S. frugiperda* larvae burrow through the husk and feed preferentially on the side of the ear (Capinera 2011, Pub. EENY-098, University of Florida) is not supported by findings in this study. Instead, both species fed down through the silk channel before attacking the kernels at the tip of the ear, similar to findings by Morrill and Greene (1973, Environ Entomol. 2: 195 - 198).

Regardless of species combination (alone or associated), densities of 1 and 2 larvae/ear comprised >75 and <20% of total population, respectively (Fig. 1). Less than 5% of all counts corresponded to densities of 3 - 7 larvae/ear. This indicates cannibalism within species and predation between species was in the final phase when sampling took place at milk-dough stage. It is likely that higher densities at earlier stages (silking and blister) may have resulted in higher intra and intercompetition, as shown in other pairs of cooccurring insects competing for the same food (Woodson 1994, Environ. Entomol. 23: 612 - 616). This study may contribute to a better understanding of the association between *H. zea* and *S. frugiperda*.

## Acknowledgments.

The authors thank Marlin E. Rice and David L. Dorhout (Pioneer) for their helpful comments on an earlier draft of this manuscript.