N O T E

Lambsquarters in a Maize Agroecosystem: A Potential Refuge for Natural Enemies of Fall Armyworm (Lepidoptera: Noctuidae) Larvae[1]

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Lambsquarters, *Chenopodium album* (L.), in weedy maize and cabbage fields serves as host to various noctuid larvae. This annual weed is present during much of the spring and summer growing season in Florida. We have noted the presence of adult parasitoids and predators searching on the lambsquarters infested with noctuid larvae. The purpose of this study was to determine the species composition and abundance of noctuid larvae and their parasitoids on lambsquarters in a north Florida maize field in efforts to evaluate its potential as a nursery crop for enhancement of biological control of the fall armyworm, *Spodoptera frugiperda* (J. E. Smith).

The study site was a 10.4-ha field planted to maize (field corn), located in Putnam Co., FL. Maize was planted on 15 April 2000 in rows 321 m long and 1 m apart. Lambsquarters grew abundantly along the irrigation ditches which ran the length of the field every sixteenth row. Three sample sites were located equidistantly down each of four irrigation ditches each of which were three planting beds apart (approximately 80 m) and three beds in (approximately 50 m) from the field edge. We sampled 10 consecutive plants at each of 12 sample sites, starting with a randomly chosen plant. The plants were cut at soil level and placed in paper bags in the field for study in the laboratory. The sampling was initiated 23 May 2000 and repeated every week for 5 wks. Infested lambsquarters found along field roads adjacent to study plots were returned to the laboratory for determination of adult parasitoid species composition found emerging from noctuid larvae. Larvae were allowed to feed on fresh, uninfested lambsquarters and artificial diet until emergence of adult parasitoids. Adult parasitoids

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reared from noctuid larvae were sent to the Division of Plant Industry, Gainesville, FL, for identification.

In the laboratory, the number of lepidopteran larvae were recorded and tabulated. Noctuid larvae were dissected to determine levels of parasitism and species of parasitoid based on laboratory photographs and drawings of immatures. Other adult beneficials were noted as present in a sample [e.g., *Orius insidiosus* (Say) (Heteroptera: Anthocoridae)] but were not tabulated because the sampling method used was not appropriate to estimate populations of mobile predators and adult parasitoids.

Noctuid larvae were detected on lambsquarters throughout the study, with the highest populations detected in the first 3 wks (Fig. 1). Species of noctuid larvae present were beet armyworm [*Spodoptera exigua* (Hübner)], southern armyworm [*Spodoptera eridania* (Cramer)] fall armyworm, and cabbage looper [*Trichoplusia ni*

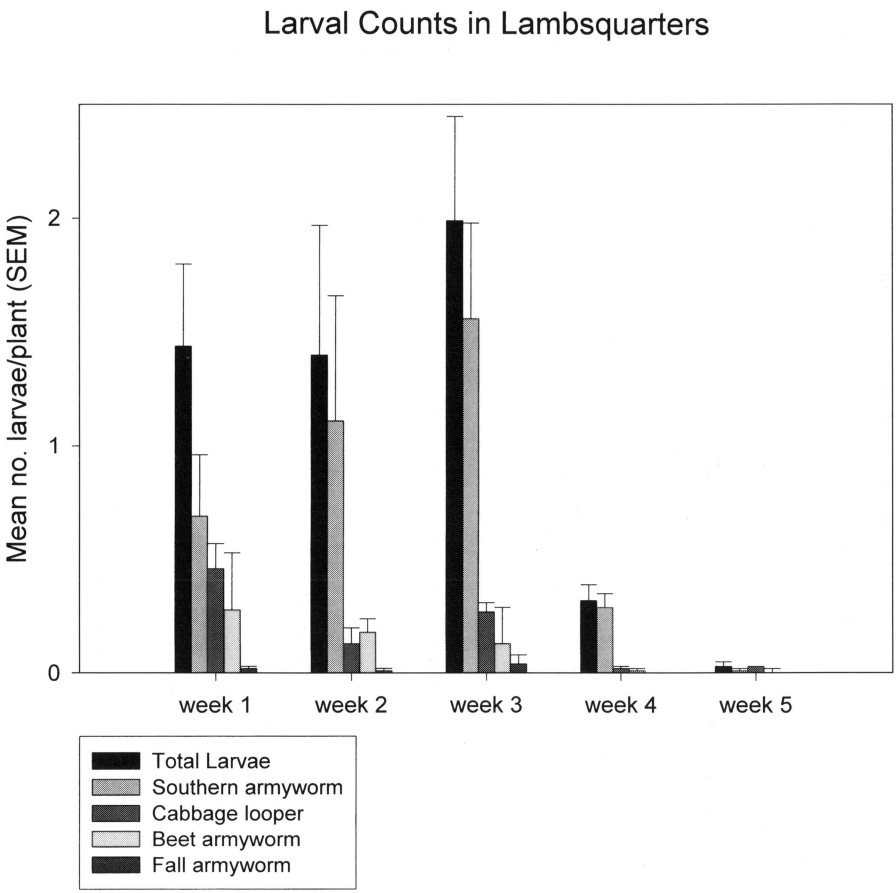

Fig. 1. Abundance (mean no. larvae/plant ± SEM) of noctuid larvae on lambsquarters located along irrigation ditches in a north Florida maize (field corn) field. Ten plants were sampled per site; a total of 12 sites were sampled each week.

(Hübner)]. The mean number of all noctuid larvae combined ranged from 1.4 to 2.0 larvae/plant during the first 3 wks, dropped to 0.3 larvae/plant in Week 4, and to 0.03 larvae/plant in Week 5. Numbers of southern armyworm increased during the first 3 wks, and numbers of beet armyworm and cabbage looper decreased over time. Southern armyworm was the dominant noctuid species throughout the study. Relatively few fall armyworm, a serious pest of maize, were found on the lambsquarters (mean ranged between 0 to 0.04 larvae/plant).

High levels of parasitism were detected in the noctuid larvae with mean percentages of parasitized larvae ranging between 20 to 45% (Fig. 2). During the first 3 wks, larval counts and parasitism of beet armyworm, southern armyworm and cabbage looper reached high levels in some of the sample sites (Fig. 1). Almost all of the parasitoids (98%) detected in the dissections were *Cotesia marginiventris* (Cresson) (Hymenoptera: Braconidae). A few *Meteorus autographae* (Muesebeck) (Hymenop-

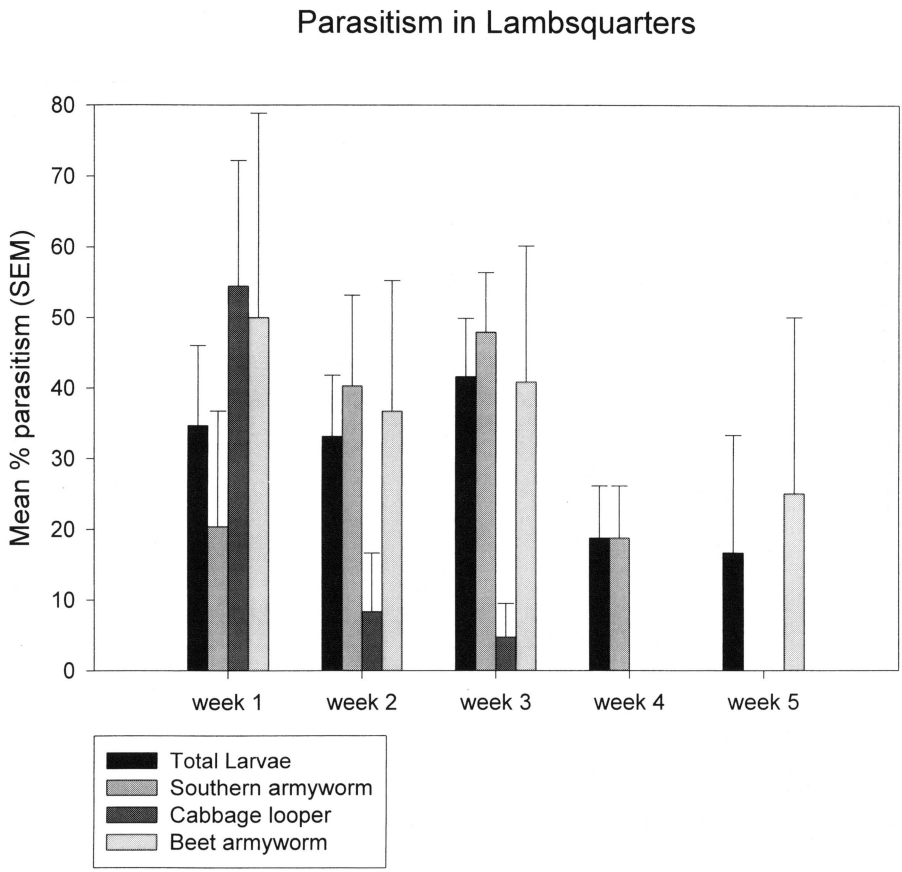

Fig. 2. Parasitism levels of noctuid larvae detected on lambsquarters located along irrigation ditches in a north Florida maize (field corn) field. Parasitism was determined by dissecting collected larvae in the laboratory.

tera: Braconidae) were detected (2%). Adult parasitoids which were allowed to develop from other lambsquarters collections included *C. marginiventris, M. autographae,* a gregarious *Cotesia* species, a *Conura* spp., and an external parasitoid *Chetogena scutellaris* (Wulp) (Diptera: Tachinidae). Adult and immature *O. insidiosus* were present in most samples throughout the duration of the study. The presence of unidentified spiders, coccinellid larvae, and syrphid larvae were noted, but were not seen as frequently as *O. insidiosus.*

The natural enemies hypothesis predicts that there may be greater diversity and abundance of beneficial insects in some polycultures than in monocultures due to the availability of alternative hosts, diverse microhabitats, and additional sources of nectar and pollen (Risch 1981. Ecology 62: 1325-1340; Root 1973. Ecol. Monogr. 43: 95-124 reviewed by Smith and McSorley 2000. Amer. Entomol. 46: 153-161). Weedy culture in maize agroecosystems may be a significant source of parasitoids (Andrews 1988. Florida Entomol. 71: 630-653) and predators (Altieri and Whitcomb 1979. Florida Entomol. 62: 175-182) of the fall armyworm. Our study has demonstrated that there is an abundance of alternative hosts present on lambsquarters for parasitoids (e.g., *C. marginiventris, M. autographae*) that also attack the fall armyworm. The most abundant noctuid in this weed was the southern armyworm, which was heavily parasitized by *C. marginiventris.* This noctuid is not a serious pest of corn, so there is little risk that lambsquarters will act as a source of a corn pest should southern armyworm larvae leave the weed and move to the main crop. Additionally, very few fall armyworm were found on the weed, so there is little risk that lambsquarters is a significant source of this serious pest.

Our results were similar to those found by Tingle et al. (1978. Entomophaga 23: 343-347), where similarly high numbers of these noctuids were found on *Amaranthus hybridus* L. in Florida field corn. One notable difference between the studies is that they found *M. autographae* to be the dominant parasitoid rather than *C. marginiventris.*

We are hopeful that this information may be useful in the design of biologically-based pest management programs for the fall armyworm. The growth of lambsquarters could be encouraged in and around corn, serving as an early-season reservoir for fall armyworm natural enemies. However, future studies need to be conducted before we can reach general conclusions about the utility of this strategy for management of the fall armyworm. Natural southern armyworm populations could be encouraged to infest the weeds by eliminating pesticide use in the weeds, or, alternatively, populations of southern armyworm could be introduced to the weeds early in the season, perhaps after being parasitized by *C. marginiventris* in the laboratory.

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