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**LANGOSTA: A LEPIDOPTEROUS PEST COMPLEX ON SORGHUM AND MAIZE IN HONDURAS**

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**ABSTRACT**

A lepidopterous pest complex, collectively referred to as “langosta” by subsistence farmers, is an important constraint to sorghum and maize production in southern Honduras. The objectives of this study were to identify the insect species in the langosta complex, determine their population density and their relationships to crop and non-crop vegetation. Relative and destructive whole plant samples were taken on intercropped sorghum and maize from May to August in plots managed using farmer’s technology and farmer’s technology plus weed control in 1988 and 1989. Weed identity and density were recorded. Spodoptera frugiperda (J. E. Smith), S. latifascia (Walker), Metaponpneumatana rogenhoferi (Moshcler), and Mocia latipes (Guenée) larvae were identified as the principal insect species in the langosta complex.

The fall armyworm, S. frugiperda, was the predominant species collected throughout the study period. Spodoptera latifascia and M. rogenhoferi were present only early in the season. Populations of S. frugiperda on the crops were higher in plots without weeds; Spodoptera latifascia and M. rogenhoferi populations did not appear to be influenced by non-crop vegetation in the treatment plots, but were influenced by vegetation adjacent to plots where they fed prior to planting. The grass looper, M. latipes, was present in mid-season and populations on sorghum and maize were higher in plots without weed control.
RESUMEN

Un complejo de lepidópteros plagas, colectivamente conocido por agricultores de subsistencia como "langosta", es una limitante importante para la producción de sorgo y maíz en el sur de Honduras. Los objetivos de este estudio fueron identificar las especies de insectos en el complejo langosta, determinar su densidad poblacional y su relación con dichos cultivos, así mismo como con la vegetación de malezas. Muestreos relativos y destructivos fueron tomados en plantas de sorgo y maíz intercalados de mayo a agosto durante 1988 y 1989. La densidad y densidad de las malezas fue registrada. Larvas de Spodoptera frugiperda (J. E. Smith), S. latifascia (Walker), Metapomp Wimbledon rogenhoferi (Moschler) y Mocis latipes (Gueene) fueron identificadas como las principales especies. El gusano cogollero, S. frugiperda, fue la especie más común a través del estudio; por otro lado, S. latifascia y M. rogenhoferi estuvieron presentes solamente al inicio de la temporada de cultivo. Las poblaciones de S. frugiperda en los cultivos fueron mas altas en parcelas sin malezas; S. latifascia y M. rogenhoferi aparentemente no fueron influenciados por la vegetación de malezas en las parcelas en estudio, pero fueron influenciados por la vegetación de malezas en áreas adyacentes, donde se alimentaron antes de la siembra de los cultivos. El gusano medidor, M. latipes, estuvo presente a mediados de la temporada de cultivo y las poblaciones de este en sorgo y maíz fueron mas altas en parcelas sin control de malezas.

Maize, Zea mays L., and sorghum, Sorghum bicolor (L.) Moench, are the first and third most important basic grains produced in Honduras (Secretaria de Planificación 1987). Ninety percent of the sorghum acreage in southern Honduras is intercropped with maize because of adverse environmental and agronomic conditions which are best characterized by erratic precipitation, high temperature, and low soil fertility (Mecenkoock 1988, Secretaria de Recursos Naturales 1986). Therefore, if the maize crop is lost to drought, farmers substitute sorghum for maize to feed their animals and family (DeWalt & DeWalt 1987).

Insect pests are an important constraint to sorghum and maize production in southern Honduras (DeWalt & DeWalt 1982). Research has shown that different types of larvae damage sorghum and maize, but peasant farmers in southern Honduras do not distinguish between species of larvae and tend to group them as one. They refer to this group of larvae as the "langosta", a term used to describe the extensive feeding damage associated with locust populations. Langosta in Spanish means locust.

The langosta was reported by DeWalt & DeWalt (1982) to be a major insect pest around Pespire, southern Honduras. Pitre (1988) reported the extensive damage caused by several insect larvae to sorghum and maize during the early growing season, and identified the langosta as a complex of noctuids including S. frugiperda, (J. E. Smith) (fall armyworm), Metapomp Wimbledon rogenhoferi (Moschler), Spodoptera latifascia (Walker), and Mocis latipes (Gueene). Based on observations, he suggested a close relationship existed between the species in the complex and non-crop vegetation present in infested fields.

It is widely stated (e.g., Altieri 1980) that in most agricultural systems, lower herbivore populations are observed when intercropping practices are used or when crops are intermingled with weeds. However, in southern Honduras, seedling sorghum and maize can be destroyed by the langosta which also infests non-crop vegetation and then migrates to field crops (Pitre 1988). The agro-ecosystems in this area vary with particular differences in soil, slope, rainfall pattern, and presence of non-crop vegetation, all of which may contribute to development of insect populations in an area (Pitre 1988). The objective of this study was to collect information on the population dynamics of the components
of this lepidopterous pest complex on intercropped sorghum and maize and non-crop vegetation in southern Honduras.

MATERIALS AND METHODS

1988 Study

This study was conducted at two locations in the Department of Valle which is situated in southern Honduras. The locations were El Conchal, which is on the Pacific coastal plain (ca. sea level) near the border with El Salvador, and La Coyota which is located nearby in the foothills at 52 meters above sea level (Fig. 1). The two areas were separated by about 16 km with coordinates ca. 13° 31' N, 87° 43' W. The fields on the plains have a higher crop production technology level (land prepared with tractors or ox-pulled plows, some use of fertilizers, and insecticides applied at planting and/or on foliage) because land is more suitable for agriculture and therefore generates more income for insecticide and herbicide use and other agricultural practices. In the hills, fields predominantly have steep slopes and rocky soils and in most instances the farmers’ economic means do not permit the use of tractors or chemicals for crop protection (Pitre 1988). Use of fertilizer is limited. Native landrace sorghum and maize varieties are grown at both locations.

Results reported herein were collected on-farm and were part of a larger study which examined the influence of intercropping practices on insect pest populations. Three farms were selected at each location. Fields, 1200 m², were planted during late May and early June. Landrace sorghum and maize populations commonly grown by subsistence farmers were used on all farms. The intercropping system was sorghum and maize planted simultaneously in alternate hills on 70-90 cm rows. Two treatments were established at each farm, one representing the farmer’s technology and the other with the farmer’s technology plus weed control. Plot size of each treatment was 600 m². Atrazine, 1.5 kg/ha (80 g ai/kg), was applied preemergence in the weed free treatment and then

![Map of southern Honduras with study sites highlighted.](image-url)

Fig. 1. Research sites in southern Honduras.
followed up as needed with manual weeding to keep this plot free of weeds. Insecticide applications were made on both treatments when considered necessary (plants receiving extensive defoliation) by the farmer. The insecticide used most often in this area is Lannate (methomyl) at rates from 0.25 to 0.5 kg a.i./hectare depending upon pest infestation and plant damage.

Non-destructive plant samples (plants searched with minimum damage) were taken from the center area (5 × 5 m) of each treatment. Ten sorghum hills (ca. 8 plants/hill) and 15 maize hills (ca. 3 plants/hill) were sampled every three days during seedling and early whorl stages, and weekly or bi-weekly during mid-whorl stages to maize maturity. Whole plants in each hill were examined and the number and identity of the lepidopterous pests present were recorded; the same hills were examined on each sampling date. Although whole plant samples require more time, the information obtained is more accurate than sampling using many other procedures.

Non-crop vegetation (weeds) in the fields was sampled every two weeks. Four stations of 0.25 m² each were set up at predetermined locations in each treatment at planting. Data collected included visual estimation of percentage of ground area covered by weeds, weed diversity, and presence or absence of larvae feeding on the weeds. Weeds were collected and sent to the Panamerican Agricultural School at El Zamorano, Honduras for identification.

1989 Study

The same locations, planting system, and crop varieties used in 1988 were used in 1989. Because of extreme differences in planting dates, the 1989 study used only two of the three farms established in both the hills and the plains. Treatments were established as in 1988; however, plot size was 400 m² for a net total area of 800 m² on each farm. Herbicide use, manual weed control, and insecticide application was as discussed for the previous year. Sample size consisted of observations on 15 sorghum plants and 25 maize plants selected at random in each plot (ca. 10% of the plant population was sampled throughout the season). Destructive plant sampling methods as described by Castro et al. (1989) were used. Sampling frequency was as described for the 1988 study. Fewer plants were sampled in 1989 than in 1988 because the whole plant sampling technique provided more accurate information on the total insect infestation (larvae of all sizes) on the crops. The identity and absolute number of the lepidopterous pests present were recorded. The same data types were recorded on the non-crop vegetation except sampling areas were selected at random; predetermined locations were not used.

The chi-square test of homogeneity was performed on data for both years over the proportions (pooled data for the two treatments and crops for each location, Fig. 4) of *S. frugiperda*, *S. latifascia*, *M. rogenhoferi* and *M. latipes* encountered during early, mid- and late season (Daniel 1990).

Results and Discussion

Spring rains triggered the onset of the lepidopterous complex on both maize and sorghum. The fall armyworm was the predominant insect species in fields in the foothills and plains (Figs. 2-4). Although abundance of *S. frugiperda* varied between locations and years, its predominance was not altered, except when considering seasonal occurrence, where at some locations the other species were more abundant (Fig. 5). The chi-square test for homogeneity indicated that the proportions of these four lepidopterous species occurring during early, mid- and late season were not significantly heterogeneous at any one location or year. Because of the size of the contingency table for this test (3 × 4), interpretations of these results do not necessarily mean that all proportions were
Fig. 2. Population densities of a lepidopterous complex on maize in southern Honduras, 1988. A) plains, plots with farmer's technology, B) plains, plots with farmer's technology and weed control, C) hills, plots with farmer's technology, and D) hills, plots with farmer's technology and weed control. S.f = Spodoptera frugiperda, M.r = Metaponopneumata rogenhoferi, S.1 = Spodoptera latifascia, M.1 Mocis latipes.

homogeneous throughout the table. And at specific times in the season, especially when the proportions of S. frugiperda were much higher than that of the other species, the proportions may not be homogeneous (Fig. 5) (Daniel 1990).

In 1988, the abundance of S. frugiperda was greatest in fields on the plains (Figs. 2, 3), whereas in 1989 this species was more abundant in the hills (Fig. 4). In both years, S. frugiperda showed a preference for maize over sorghum regardless of location; ca. 70% of the larvae was recorded on maize. This is consistent with other reports (Castro et al. 1989, Van Huis 1981). The S. frugiperda population density peaked at mid-season (late June to early July) before initiating a gradual decline. Population density for this species was as high as 0.9 larvae/maize plant in 1988 (Fig. 2B) and 0.7 larvae/maize plant in 1989 (Fig. 4D). Spodoptera frugiperda was also observed acting as a cutworm, causing considerable damage to plant stands in both years. However, the principal feeding damage caused by this pest is to whorl foliage.

Weeds influenced densities of S. frugiperda and M. latipes. In general, when weed infestation was high (pooled average of 60% of ground covered in 1988 and 35% in 1989) the S. frugiperda population was lower on sorghum and maize than when weed infestation was low (pooled average of 20% of ground covered in 1988 and 10% in 1989), but the M. latipes population was higher when weed infestation was high (Figs. 2-4). Both S. frugiperda and M. latipes were observed feeding on the predominant weed grass
Ixophorus unisettes (Pres. L.) Schlecht on the plains. This grass was not present in the hills where legumes were more commonly observed both in and outside production fields. Ixophorus unisettes appeared to be as suitable as maize for S. frugiperda larval feeding. Thus the larvae were distributed over the non-crop and crop vegetation resulting in lower infestation on the crops. Studies on the suitability of this grass species and other non-crop vegetation to S. frugiperda and other lepidopterous pests in the langosta complex are needed to elucidate the role of these plants in the dynamics of the pest species.

First instar larvae of M. latipes were observed feeding on the weed grasses I. unisettes and Echinocloa colonum (L.) Link, (both were present on the plains but only E. colonum was observed in the hills). As these larvae developed and their extensive and aggressive feeding habits exhausted this preferred habitat, later instars migrated to surrounding sorghum and maize. Thus, somewhat higher populations of M. latipes were observed on the crops in treatments with highest densities of these weed grasses (Figs. 2A, C; Fig. 3C; Fig. 4A). Dean et al. (1985) reported that M. latipes moths preferred certain weed grasses over maize for oviposition and that early instar larvae develop to later instars on these grasses during the time that they were building to higher populations. This would explain the somewhat lower infestations observed in the treatments with low weed infestation (Figs. 2B, D; Fig 3D; Fig 4B). Mocis latipes larvae
Fig. 4. Population densities of a lepidopterous complex on sorghum and maize in southern Honduras, 1989. A) plains, plots with farmer's technology, B) plains, plots with farmer's technology and weed control, C) hills, plots with farmer's technology, and D) hills, plots with farmer's technology and weed control. S.f = Spodoptera frugiperda, M.1 = Mocis latipes.

were recorded in low numbers in the hills during early season (first three weeks of June; Figs. 2C, D; 4C), but populations in both locations peaked during early July to early August, at which time maize plants had silks emerging or were in the blister stage (Figs. 2A, B, C; Figs. 3A, B, C; Fig. 4A). Their density increased to a high of 0.2 larvae/plant in 1988 (Fig. 2A) and to 0.7 larvae/plant in 1989 (Fig. 4A). Although this species represented 70% of the insect complex on sorghum and maize late in the season on the plains during 1989 (Fig. 5C), it contributed to no more than 15% in any other location or year (Figs. 5A, B, D). Sorghum and maize were equally infested by this species. The feeding behavior of M. latipes is characterized by consumption of the leaf blade leaving only the midrib and this damage is similar to that of locust. Farmers usually apply insecticides to reduce infestations of this pest and prevent yield loss.

The other two species in the complex, M. rogenhoferi and S. latifascia, were observed on sorghum and maize only during the early season in 1988 (late May to mid-June) (Figs. 2, 3). Populations of these two species were higher in the hills than on the plains and peaked in early June. Their densities increased to 0.3 and 0.2 larvae/plant, respectively before disappearing by late June (Fig. 2D). These two species represented the highest initial percentage (58% and 14%, respectively) of the complex on sorghum and maize at the onset of the season in the hills. Of the larvae collected, on average 80% of M. rogenhoferi and 70% of S. latifascia were recorded on indigenous maize which was strongly preferred to exotic sorghum. An attempt was made to rear these larvae in the
Fig. 5. Percentage of species composition of a lepidopterous complex in southern Honduras. A) plains, pooled data, 1988, B) hills, pooled data, 1988, C) plains, pooled data, 1989, D) hills, pooled data, 1989. S.f = Spodoptera frugiperda, M.r = Metaponpneumata rogenhoferi, S.1 = Spodoptera latifascia, M.1 = Mocis latipes.

laboratory but adults failed to emerge from pupae, suggesting that maize and sorghum may be sink habitat. A sink habitat is "an area where (environmental) factors are not sufficient for a species to carry out its life history" (Pulliam 1988). The degree of acceptability of these plants as hosts for these pests should be determined.

Although M. rogenhoferi and S. latifascia were not recorded in treatments in 1989, they were observed feeding in large numbers on non-crop vegetation adjacent to fields prior to planting on the plains and in lower densities on some sorghum and maize seedlings planted in fields during late April and early May in the hills. The non-crop vegetation was the earliest available host plants. The main environmental difference during the two year study was that the rains initiated first in the hills in 1988, whereas the opposite was true for 1989. It is plausible that the source habitat of M. rogenhoferi and S. latifascia exists in the foothills or further inland. A source habitat is "the range of values of environmental factors that are necessary and sufficient to allow a species to carry out its life history" (Pulliam 1988). Pitre (1989) observed fall armyworm larvae in all stages in grasses growing in and along irrigation ditches on the plains in southern Honduras during the dry season. Related species may also survive in this habitat during periods when suitable host plants are not present in dry areas before the rainy season in this region. Accordingly, when these colonists left their dry season niche in the hills at the onset of the rains in 1989, there was already sufficient non-crop vegetation to sustain the population in the coastal plains; whereas in 1988, the colonists arrived on the plains when green vegetation was sparse and were forced to migrate to surrounding marginal habitats like maize and sorghum once preferred non-crop vegetation had been ravaged.
Preliminary laboratory feeding preference studies conducted with *M. rogenhoferi* and *S. latifascia*, which were collected on non-crop vegetation adjacent to fields in 1989, indicate that these species can develop on *Thrionthema portulacastrum* L. (Aizoaceae), *Cassia leiophila* Vogel (Leguminosae), *Ipomoea* sp. (Convolvulaceae), *Melampodium divaricatum* (Rich. ex pers) DC (Compositae) and *Amaranthus spinosus* L. (Amaranthaceae), (H. Portillo, unpublished data). These are five of the most common broad leaf weed species found in fields in southern Honduras. *Spodoptera latifascia* did not develop as well on mature sorghum and maize leaves as on some of the weeds. The feeding behavior of *M. rogenhoferi* and *S. latifascia* is very similar. They both feed on young outer plant leaves, but do not move into the whorl. Seedlings are cut at the growing point and die (deadheart). Plant stands will be dramatically reduced if no insecticide is used. Their most damage is usually inflicted in the hills where poor farmers can not purchase insecticides.

**Fall Armyworm and the Langosta Challenge**

The occurrence of the lepidopterous pest complex (langosta) on sorghum and maize creates the biological illusion that the component species coexist conjointly. Actually, the complex is the product of a fine-grained mosaic of different micro-habitats, each supporting a well-adapted successful species. Except for *S. frugiperda*, sorghum and maize apparently serve as a sink habitat where the net lepidopterous population decreases, and survival and population increase depend on nearby non-crop source habitats. Source and sink habitats serving to complicate ecology have been discussed by Lewin (1989).

Because of the geographical and biological diversity involved by the complex, controlling the langosta is a formidable challenge. Although many farmers spray their crops after the langosta has arrived, this has no effect on the core population of at least two of the species, nor does it reduce their subsequent generations since these species are unable to complete or appear to have difficulty in completing their life cycle on maize and sorghum.

More effective control measures would include management of non-crop vegetation or source habitats. Monitoring source habitats and synchronizing planting dates to follow migration would be a low cost control measure that could be employed by subsistence farmers. Likewise, destruction of relatively small source habitats before planting could lead to local population extinction of some pest species. These tactics are within the means of resource poor farmers since they primarily involve investment of their own labor. Insecticide applications could contain the insect pest in the source habitat but it is unlikely that subsistence farmers will be willing to invest in spraying weeds.

The diversity of the lepidopterous pest complex ensures that sustaining adequate control of the langosta will depend on an array of integrated pest management practices. Because manipulation of a niche may affect one species adversely only to benefit another, as in the case with weed control which reduced the population of *M. latipes* but increased population size of *S. frugiperda*, a greater understanding of the ecology behind each species is required before a technological control package can be developed. Other areas of additional needed research include host oviposition preference of moths, additional studies on feeding preference including young and old plant tissues, and parasitization of larvae.

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