

Color identification of economically important *Spodoptera* larvae in Honduras (Lepidoptera: Noctuidae)

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Abstract

Spodoptera frugiperda (J. E. Smith), *S. exigua* (Hübner), *S. latifascia* (Walker), *S. ornithogalli* (Guenée), *S. dolichos* (Fabricius), *S. sunia* (Guenée), and *S. eridania* (Cramer) are commonly associated with crops in Honduras. A key to these species with color illustrations of rare and typical forms is presented. Potential problems in identifying *Spodoptera* species are discussed.

Additional key words: morphology, Noctuoidea

Introduction

The noctuid genus *Spodoptera* contains many pests throughout the world (Kranz et al. 1977, Hill 1975). At least eight species are known to occur in Honduras. *Spodoptera frugiperda* (J. E. Smith), *Spodoptera exigua* (Hübner), *Spodoptera latifascia* (Walker), and *Spodoptera sunia* (Guenée) are considered economically important pests whereas *Spodoptera eridania* (Cramer), *Spodoptera ornithogalli* (Guenée), and *Spodoptera dolichos* (Fabricius) are rarely abundant enough to cause serious damage to Honduran crops (Passoa 1983). An adult *Spodoptera androgea* (Cramer) was collected on the north coast of Honduras (La Lima, Department of Cortes) in October, but its larva is unknown. The host range of *Spodoptera* is very wide including most vegetable crops and several basic grains (Passoa 1983, Andrews 1984, King and Saunders 1984). Information on the distribution, phenology, Spanish common names, biology, and control of *Spodoptera* spp. can be found in the works cited above.

In spite of a logical and thorough study by Levy and Habeck (1976), workers in Latin America sometimes have trouble identifying *Spodoptera* larvae. Two examples illustrate this problem. In King and Saunders (1984), several *Spodoptera* speci-

mens are misidentified (Figures 9.1, 9.4, and 11.2 label three forms of *Spodoptera latifascia* as *S. dolichos*, *S. eridania*, and *Spodoptera ornithogalli*, respectively). A guide to soybean pests in Brazil (Gazzoni et al. 1981) incorrectly labeled a photograph of *S. sunia* as *S. eridania*.

This work should facilitate identification of common *Spodoptera* larvae in Honduras by presenting illustrations of typical and unusual color forms. Careful attention to details of the color pattern will allow accurate identification of most *Spodoptera* species, although great variation in larval markings makes the identification of all aberrant individuals impossible.

Methods and Materials

Most of the specimens used in this study were collected in Honduras, Central America, from 1979-1981. Additional specimens from Ohio, Illinois and Florida were also studied. Field-collected larvae were photographed, reared to adult, and then identified with Todd and Poole (1980). Eggs laid by female moths in captivity provided another source of larval material. Beans (*Phaseolus vulgaris* L.), sweet potato (*Ipomoea batatas* (L.) Poir.) or wheat germ artificial diet were all accepted by *Spodoptera*

larvae in laboratory feeding trials. Larval specimens were killed in a 9:1 mixture of 80% ethanol and glacial acetic acid by volume, then transferred to 80% ethanol after 24 hours for permanent storage. Larval terminology follows Stehr (1987). The hypopharyngeal complex was mounted in glycerin and examined under a compound microscope. Only the most common synonyms are mentioned under each species, for a more complete list see Todd and Poole (1980).

Characters to separate *Spodoptera* from other common pest noctuids in Honduras

The following combination of structural and color characteristics will separate *Spodoptera* spp. from other common pest noctuids in Honduras. The polarity of most of these characters are unknown although the presence of a sclerotized bar around the mesothoracic SD 1 seta seems to define a clade which includes *Spodoptera* and related genera.

1. Four abdominal prolegs present (larva not a looper).
2. Two SV setae present on first abdominal segment (Fig. 2).
3. Lateral spot usually present on first abdominal segment (this spot is a practical method of recognizing *Spodoptera* larvae in the field) (Fig. 2, 26).
4. Mesothorax with a sclerotized bar connecting the SD 1 seta and a tonofibrillary platelet (Fig. 3).
5. No retinaculum on the mandible (Fig. 5).
6. Hypopharyngeal complex with coarsely spined posterior portion lacking a dense brush of stout bristles (Fig. 7).
7. Adfrontal sutures do not extend to epicranial notch (Fig. 8).
8. Skin smooth under a magnification of 25 power (except in *Spodoptera frugiperda*) and never with microspines.
9. Head with an inverted "Y" because adfrontal areas are outlined in white (see discussion under *Spodoptera frugiperda*) (Fig. 32).

Key to common *Spodoptera* larvae in Honduras

(modified from Levy and Habeck 1976, Oliver and Chapin 1981, Crumb 1956, and Godfrey 1987)

1. Dorsal pinacula usually conspicuous (Figs. 12, 14) but sometimes pale in the green form (Fig. 13), their diameter equal to or greater than the diameter of the abdominal spiracles dorsum of abdominal segments granulated under a magnification of 25 power or greater (Fig. 4)
..... *Spodoptera frugiperda* (J. E. Smith)
- 1'. Dorsal pinacula never conspicuous, their diameter less than the diameter of the abdominal spiracles dorsum of abdominal segments smooth under magnification of 25 power 2
2. Abdominal segments never with dorsal triangular markings, pattern consists of a series of dorsal dashes (Fig. 6) or, more commonly, an irregular series of white dots and lines (Fig. 15) lateral spot, if present, is on the mesothorax (Fig. 1) ventral tonofibrillary platelets between abdominal prolegs form a "Y" with a short stem about as long as the arms (Fig. 9)
..... *Spodoptera exigua* (Hübner)
- 2'. Abdominal segments with at least one pair of dorsal triangular markings (Figs. 2, 11, 23) lateral spot, if present, is on the first abdominal segment (Figs. 2, 19) ventral tonofibrillary platelets between abdominal prolegs form a straight line or, more rarely, a "Y" with a very long stem compared to the arms (Fig. 10) 3
3. Lateral spot on the first abdominal segment, when present, interrupts the subspiracular line to form a pale, thinner line on the thorax (Fig. 19) if lateral spot and/or subspiracular line are absent (Figs. 18, 20), then dorsal triangles of first abdominal segment larger than dorsal triangles of fourth abdominal segment (Fig. 17)
..... *Spodoptera eridania* (Cramer)
- 3'. Lateral spot on the first abdominal segment, when present, does not interrupt the subspiracular line and therefore the line maintains equal intensity and width on the thorax compared to the abdomen if lateral spot and/or subspiracular line are absent, then dorsal triangles of first abdominal segment not larger than dorsal triangles of fourth abdominal segment (Fig. 11) 4
4. Dorsal triangles with a narrow white line (either solid or composed of dashes) passing through them (Fig. 27), if lines are inconspicuous or absent in dark forms (Figs. 24-25, 28), then area below subdorsal stripe with several longitudinal narrow white lines (Fig. 24) dorsal mesothoracic marking either triangular, elongate-oval, or semi-circular (Figs. 11, 32)
..... *Spodoptera ornithogalli* (Guenée)
- 4'. Dorsal triangles never with a narrow white line passing through them, although a series of white

- dots may be present (Figs. 31, 34) area below subdorsal stripe without several longitudinal narrow white lines except for the black form of *S. latifascia* (Fig. 34) dorsal mesothoracic markings semicircular or trapezoidal (Figs. 32, 33), never triangular or elongate-oval 5
5. Dorsal triangles with a white spot close to or at their apex (Fig. 22) if triangles are absent then at least some of the white dots are bordered by black semicircles (Fig. 23) *Spodoptera sunia* (Guenée) 5
- 5'. Dorsal triangles without a white spot close to their apex although a white spot may be present below the triangles on the subdorsal line (Fig. 30) 6
6. Mesothoracic dorsal markings usually semicircular (Figs. 32, 34) and smaller than dorsal triangles on eighth abdominal segment (Fig. 11) rarely mesothoracic dorsal markings are replaced by a white spot (Fig. 31) *Spodoptera latifascia* (Walker) 5
- 6'. Mesothoracic dorsal markings trapezoidal (Fig. 30) and subequal to dorsal triangles on eighth abdominal segment (Fig. 29), these markings never replaced by a white spot *Spodoptera dolichos* (Fabricius) 6

Discussion

Spodoptera (=Laphygma) *frugiperda* (J. E. Smith); fall armyworm.

Usually *Spodoptera frugiperda* is readily distinguished by its large pinacula (Figs. 12 and 14). However, the green form of *S. frugiperda* can be confused with *Spodoptera exigua* (compare Figs. 13, 15 and 16) because the pale pinacula of *S. frugiperda* are easy to overlook, especially in field surveys. Cuticular texture can also be used to distinguish these two species. *Spodoptera frugiperda* has a granulated cuticular texture (Fig. 4) under a magnification of 25 power or more whereas *S. exigua* has a smooth cuticle at the same magnification. The lateral spot of *S. frugiperda*, when present, is on the first abdominal segment and not the mesothorax as is the case with *S. exigua*. Although the literature suggests *S. frugiperda* is distinguished by the white "inverted Y" on its head (Angulo and Weigert 1975), pale adfrontal areas are characteristic of other *Spodoptera* spp. (for example, Fig. 22) and many representatives in scattered families throughout the Lepidoptera.

The fall armyworm can potentially be confused

with cutworms that have granulated skin and large pinacula, for example, *Agrotis ipsilon* (Hufnagel). However, cutworms have the adfrontal suture extending to the epicranial notch (top of head) while in *S. frugiperda* the adfrontal area extends only half that distance.

Spodoptera (=Laphygma) *exigua* (Hübner); beet armyworm

A heavily-marked form of the beet armyworm was illustrated by Levy and Habeck (1976), but this color pattern is rare in Honduras. Instead, most of the larvae are speckled with white on a green background (Fig. 15). Head color varies from green to black and a thin white spiracular line may be present (Fig. 16). *Spodoptera exigua* can usually be recognized by a lateral spot on the mesothorax (see discussion under *S. frugiperda*). However, preserved specimens of *S. exigua* usually fade in alcohol and lose their color pattern so most identifications must be confirmed with structural characters. Among common noctuids in agricultural fields in Honduras, the presence of two subventral setae on the first abdominal segment (Fig. 2), a sclerotized bar connecting the mesothoracic SD 1 seta to a tonofibrillary platelet (Fig. 3), the ventral tonofibrillary platelets in the form of a "Y" with a short stem (Fig. 9), and smooth skin under a magnification of 25 power will identify *S. exigua*.

Spodoptera (=Xylomyges) *eridania* (Cramer); southern armyworm

Despite its name, the southern armyworm is not as common in Honduras as *S. frugiperda*, *S. sunia*, or *S. latifascia*. *Spodoptera eridania* has been traditionally distinguished by the spot on the first abdominal segment which interrupts the subspiracular line (Levy and Habeck, 1976). However, the term "interrupted" is somewhat misleading since the spot does not physically sit in the path of the line. Instead, the subspiracular line loses intensity as it passes below the lateral spot (Fig. 19). Most *Spodoptera* larvae have a lateral spot so the condition of the subspiracular line must be noted. The illustration of *S. latifascia* (Fig. 9.4) in King and Saunders (1984) was probably misidentified as *S. eridania* because of its prominent lateral spot.

Unfortunately, sometimes the subspiracular line of *S. eridania* is pale (Fig. 9) or absent (Fig. 8). Under these circumstances the southern armyworm is difficult to recognize. One character which appears unique to *S. eridania* is the large size of the

dorsal triangles on the first abdominal segment (Fig. 17). The presence of a white spot posterodorsad to the spiracle was used by Oliver and Chapin (1981) in their key to economically important noctuids. Although this spot is common on *S. eridania*, it also occurs in other *Spodoptera* species, for example, *S. latifascia* and *S. ornithogalli*. Levy and Habeck (1976) mentioned a uniform brown head as a backup character for recognizing the southern armyworm. This head coloration characterizes most typical specimens of *S. eridania* but sometimes the anterior portion of the epicrania may be dark brown with strong reticulations.

***Spodoptera* (=Xylomyges) sunia** (Guenée); white-spotted armyworm

Spodoptera sunia is readily identified by a white spot at the apex of the dorsal triangles (Fig. 22). If the dorsal triangles are reduced, then at least several of the spots will be ringed with black (Fig. 23), representing remnants of the dorsal triangles.

The variegated form of *S. sunia* (Fig. 21) may be hard to identify because the dorsal triangles are inconspicuous and the dorsum is flecked with white. With careful observation, a subdorsal triangle with white spot can usually be discerned.

Several species of *Spodoptera* have white spots at the bases of the dorsal triangles (Fig. 23) which potentially could be confused with the spotted triangles in *S. sunia*. Only white spots at, or near, the apex of the dorsal triangle should be used to recognize *S. sunia*.

***Spodoptera* (=Prodenia) ornithogalli** (Guenée); yellow-striped armyworm

Spodoptera ornithogalli is characterized by a thin white line, either solid or composed of dashes, which passes through the abdominal dorsal triangles. Often the line is readily visible (Fig. 27) although sometimes it may be pale and difficult to see (Figs. 24, 25). In the latter case, most individuals of *S. ornithogalli* can be recognized by having several narrow white lines under the subdorsal stripe (Figs. 24, 26). *Spodoptera ornithogalli* gets its common name from the conspicuous yellowish-white subdorsal stripe (Figs. 24, 27). Even though several other *Spodoptera* larvae have a prominent subdorsal stripe, and the stripe is not always yellow in *S. ornithogalli*, a contrasting yellow subdorsal stripe is a good indication that an unknown larva probably is *S. ornithogalli*.

Despite great variation, the shape of dorsal

mesothoracic markings can be helpful in identifying *Spodoptera* larvae. The mesothoracic spot of *S. ornithogalli* may be round, elongate-oval, or triangular. When a triangular or elongate-oval mesothoracic spot is present (Figs. 11, 28), this separates *S. ornithogalli* from *S. latifascia* and *S. dolichos*. In the latter two species the mesothoracic markings are semicircular (Fig. 32) and trapezoidal (Fig. 30), respectively.

***Spodoptera* (=Prodenia) dolichos** (Fabricius); banded armyworm

Too few specimens of *S. dolichos* are available to examine color variation. In a series of about 50 larvae reared from a female collected in Honduras, all specimens showed the characteristic mesothoracic trapezoidal markings when mature (Fig. 30). Early instars of *S. dolichos* resemble *S. latifascia* because both species have semicircular mesothoracic markings.

A new common name, the banded armyworm, is proposed here to call attention to the distinctive bands on the adult thorax which readily separate this species from other members of the genus (Todd and Poole, 1980).

***Spodoptera* (=Prodenia) latifascia** (Walker); black armyworm

Spodoptera latifascia is very common in Honduras. The body color usually is a shade of black, brown or gray. Dorsal triangular markings are either present or absent, rarely the mesothoracic dorsal markings are reduced to white dots. *S. latifascia* should not be confused with either *S. dolichos*, *S. sunia*, *S. frugiperda*, or *S. exigua*. *Spodoptera ornithogalli* can be confused with the black form of *S. latifascia* if the white markings passing through the dorsal triangles are not examined carefully. In *S. latifascia* these markings are composed of a series of dots, never a line or series of dashes as is the case with *S. ornithogalli*. In addition, the subdorsal stripe is either yellow, white, or brown (Figs. 24-26, 28) in *S. ornithogalli* while it is nearly always orange in the black form of *S. latifascia* (Fig. 34).

If additional species of *Spodoptera* larvae are included as part of a revision of the New World taxa, several characters listed below may merit further study. Whelen (1935) used tarsal claw shape in a key to Nebraska armyworms. Differences in spiracle color helped Okumura (1961) distinguish among *Spodoptera* larvae in cotton. Head color and mandible shape were generally too variable for use in

identification of Honduran *Spodoptera* larvae, although these characters might be significant if additional species are considered. The presence and color of the middorsal line varies and it is especially obvious and intense in some *S. sunia* and *S. eridania*. Ideally, *Spodoptera* larvae need to be studied by rearing females in laboratory cultures for many generations, at several densities and temperatures, on a wide variety of host plants. Only in this way can we begin to understand the extent of color variation in these insects.

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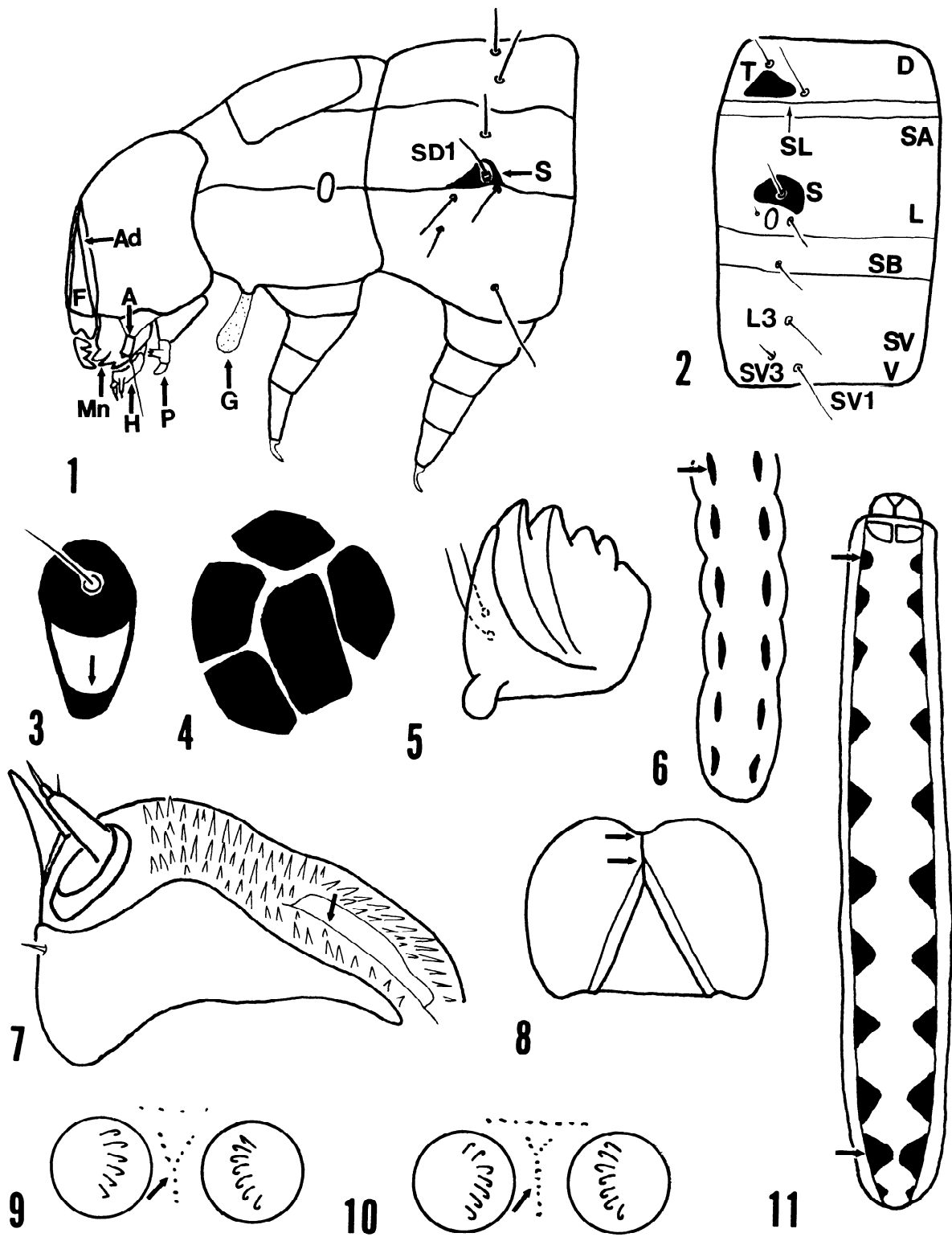
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Figure 1-11. 1) Lateral view of typical *Spodoptera* head, prothorax and mesothorax. 2) Lateral view of a typical *Spodoptera* first abdominal segment. 3) SD 1 pinaculum of a typical *Spodoptera* larva. Arrow points to a tonofibrillary platelet which is connected to the pinaculum by two sclerotized bars. 4) Granulated cuticular texture of *Spodoptera frugiperda* dorsum at high power. 5) Mandible of a typical *Spodoptera* larva showing the lack of a retinaculum. 6) Dorsal view of *Spodoptera exigua* abdominal markings that are not triangular. 7) Lateral view of typical *Spodoptera* larval hypopharyngeal complex. Arrow points to a hypopharyngeal blade which is sometimes present. 8) Anterior view of typical *Spodoptera* head showing that adfrontal area (bottom arrow) does not reach the epicranial notch (top arrow). 9) Tonofibrillary platelets between the prolegs of A3-6 in *Spodoptera exigua*. Arrow points to a "Y" with a short stem. 10) Tonofibrillary platelets between the prolegs of A3-6 in most *Spodoptera* larvae that form a straight line or a "Y" with a long stem (see arrow). 11) Dorsal view of *Spodoptera latifascia* showing that the mesothoracic markings (top arrow) are smaller than the dorsal abdominal triangles of A8 (bottom arrow). A = antenna; Ad = adfrontal area; D = dorsal area; F = front; G = prothoracic ventral gland; H = hypopharyngeal complex and spinneret; L = lateral area; L3 = third lateral seta; Mn = mandible; P = maxillary palpus; S = lateral spot of first abdominal segment; S = lateral spot of the mesothorax; SA = subdorsal area; SB = subspiracular line; SD1 = first subdorsal seta; SL = subdorsal line; SV = subventral area; SV3 = third subventral seta; SV1 = first subventral seta; T = dorsal abdominal triangle; V = ventral area.



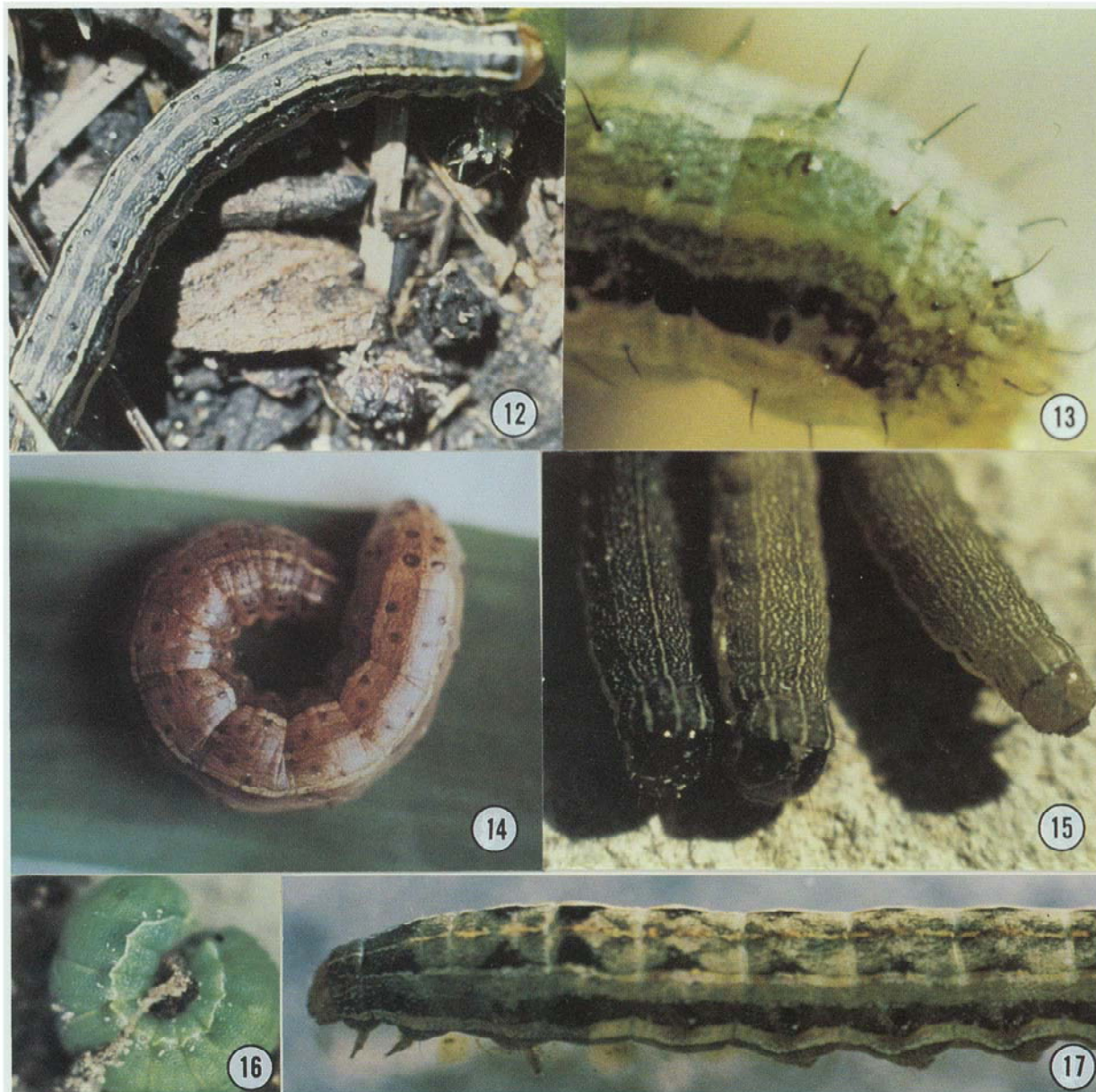


Figure 12-17. *Spodoptera* spp. larvae. Figure 12-14. *Spodoptera frugiperda*. 12) Dark form, showing conspicuous dorsal pinacula; 13) Green form, arrow points to pale pinaculum; 14) Normal brown form, showing conspicuous dorsal pinacula. Figure 15-16. *Spodoptera exigua*. 15) Normal form, showing variation in the color of the dorsum and an irregular pattern of white dots and dashes; 16) Lateral view, showing white spiracles and a white subspiracular line. Figure 17. *Spodoptera eridania*, dorsolateral view, arrow points to the large dorsal triangle on the first abdominal segment.

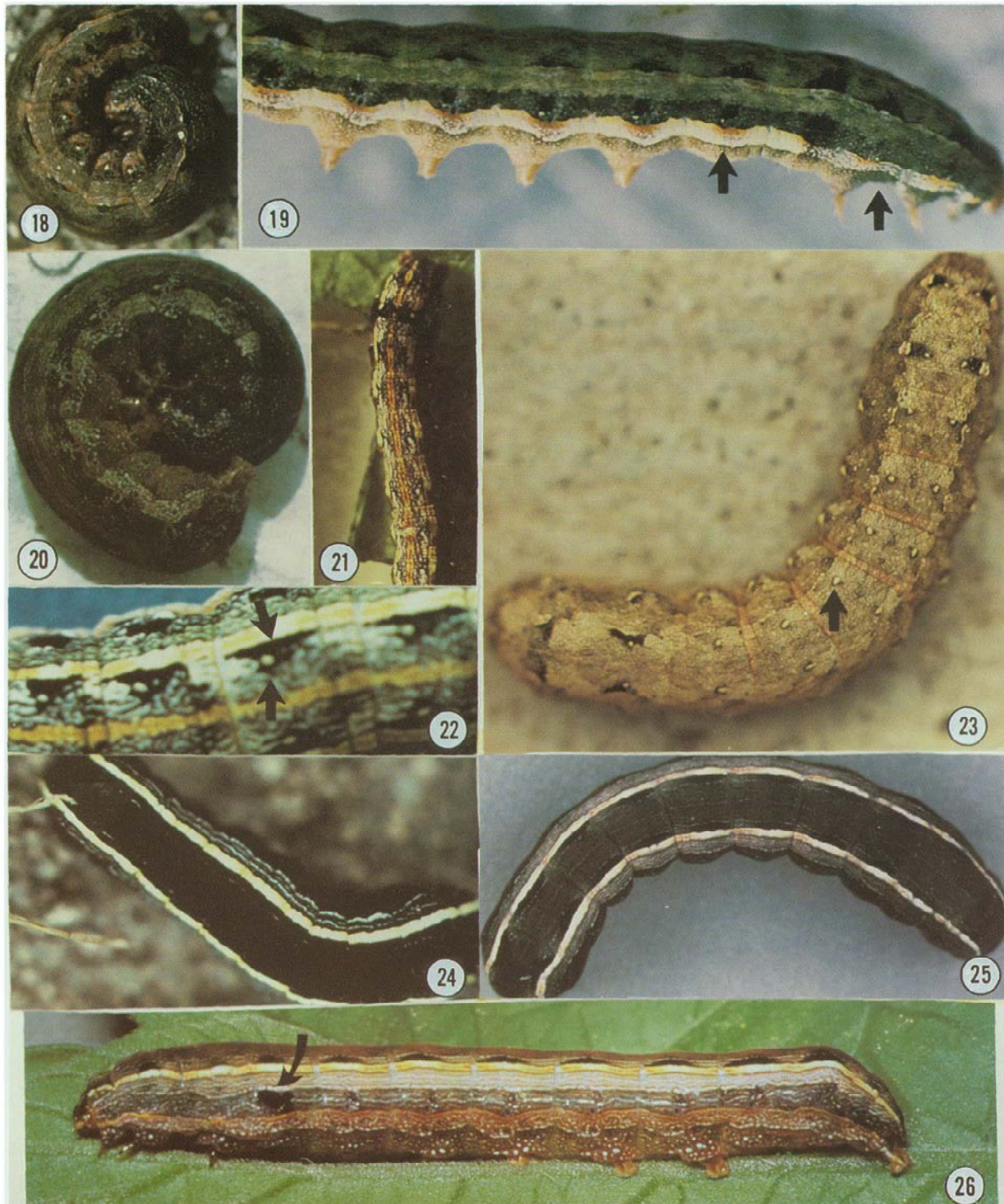


Figure 18-26. *Spodoptera* spp. larvae. Figure 18-20. *Spodoptera eridania*. 18) Dark form, showing the lack of a subspiracular stripe; 19) Normal form, showing the reduction of intensity and width of the subspiracular line as it passes under the lateral spot of the first abdominal segment. Arrows point to subspiracular line before and after it passes under the lateral spot; 20) Dark form, showing a pale subspiracular stripe. Figure 21-23. *Spodoptera sunia*. 21) Variegated color form; 22) Dorsal triangle (marked by arrows), showing a white spot near the apex; 23) Dorsal view, showing reduction of the dorsal triangles on most abdominal segments. Arrow points to a white spot ringed with black on the posterior margin. Figure 24-26. *Spodoptera ornithogolli*. 24) Black form, showing several white lines below the subdorsal stripe; 25) Dark form, showing inconspicuous lines passing through the dorsal triangles; 26) Brown form, arrow points to lateral spot.



Figure 27-34. *Spodoptera* spp. larvae. Figure 27-28. *Spodoptera ornithogolli*. 27) Normal form, showing lines passing through the dorsal triangles (see arrow) and a yellowish-white subdorsal stripe; 28) Dark form, showing inconspicuous lines passing through the dorsal triangles. Figure 29-30. *Spodoptera dolichos*. 29) Dorsal view, showing mesothoracic dorsal marking (top arrow) as large as the dorsal triangles of the eighth abdominal segment (bottom arrow); 30) Dorsal view, showing trapezoidal mesothoracic dorsal markings. Figure 31-34. *Spodoptera latifascia*. 31) Black form, arrow points to a series of white dots on the dorsum; 32) Dorsal view, arrow points to the semicircular mesothoracic dorsal marking; 33) Brown form, showing the lack of dorsal abdominal triangles; 34) Black form, showing the orange subdorsal stripe and round mesothoracic dorsal markings.

