A COMPARATIVE DESCRIPTION AND PHENETIC ANALYSIS OF THE FIRST INSTAR LARVAE OF SEVEN *STATOR* SPECIES (COLEOPTERA: BRUCHIDAE)

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ABSTRACT

The first instar larvae of *Stator chihuahua, S. generalis, S. sordidus,* and *S. vachelliae* are described. Additional descriptive information (antennae) is also provided for *S. limbatus, S. pruininus,* and *S. pygidialis.* Characters of the chaetotaxy, head, antennae, prothoracic plate, legs, anal sulcus, and egg were used, if available. A key to the larvae of these species is provided. A principal component analysis was run for purposes of comparing a numerical larval classification with a suggested adult intrageneric grouping scheme. The results indicate mutual agreement, between numerical and intuitive schemes, with respect to *S. generalis* and *S. limbatus.* Slight deviation occurs with larval group two *(S. chihuahua* and *S. vachelliae)* and significant incongruency with respect to the third larval cluster which includes *S. pruininus, S. pygidialis* and *S. sordidus.*

Pfaffenberger and Johnson (1976) ran a principal component analysis on 20 different species of bruchid larvae belonging to nine different genera to test the level of congruency between it and intuitive larval and/or adult classification scheme(s). The results indicated a rather high level of agreement (congruency) between phyletic (intuitive) and phenetic (numerical) classification systems. They were also able to demonstrate the need to use taxonomic characters from all life stages to establish accurate relationships among species and to predict, with reasonable accuracy, affinities.

The purposes of this paper are to provide larval descriptions and to test the intrageneric groupings within the genus *Stator* (Johnson and Kingsolver 1976), using characters of the chaetotaxy, legs, and prothoracic plate of first instar larvae. Those species for which new descriptions are provided include *Stator chihuahua* Johnson and Kingsolver, *S. generalis* Johnson and Kingsolver, *S. sordidus* (Horn), and *S. vachelliae* Bottimer. Additional descriptive information is also provided for *S. limbatus* (Horn), *S. pruininus* (Horn), and *S. pygidialis* (Schaeffer).

Stator chihuahua Johnson and Kingsolver

BODY: (Fig. 1) 0.3 mm wide by 0.9 mm long; appearing asetiferous; cyposomatic; width and depth greatest at meso-metathoracic segments, tapering to minute 10th segment; cuticle white to light yellow without sclerotized, pigmented areas (excepting prothoracic plate); cuticle bearing organized pattern of short (secondary) setae (cf. Fig. 1 with Fig. 1 in Pfaffenberger and Johnson 1976). *HEAD:* sclerotized; light to dark tan pigmentation; prognathous to hypognathous; dorso-ventrally flattened; nearly quadrangular (Fig. 3 in Pfaffenberger 1977); proximal end may be deeply retracted into prothorax; full length, median, goblet-shaped, epicranial suture; ocelli absent; large occipital foramen, together with mouthparts forming venter of head

capsule. *Antenna:* (Figs. 1 and 2) located at base of mandible near distal end of epicranial arm; single-segmented; retractable (Fig. 24); bearing 2, distal setae; one seta 4 to 5 times longer than other. *THORAX:* (Fig. 17) without sclerotization except for pigmented, H-shaped prothoracic plate on prodorsum; width and depth greatest in meso- and metathoracic regions; meso- and metathoracic segments divided by sutures into prodorsal, post-dorsal, epipleural, hypopleural, and sternal

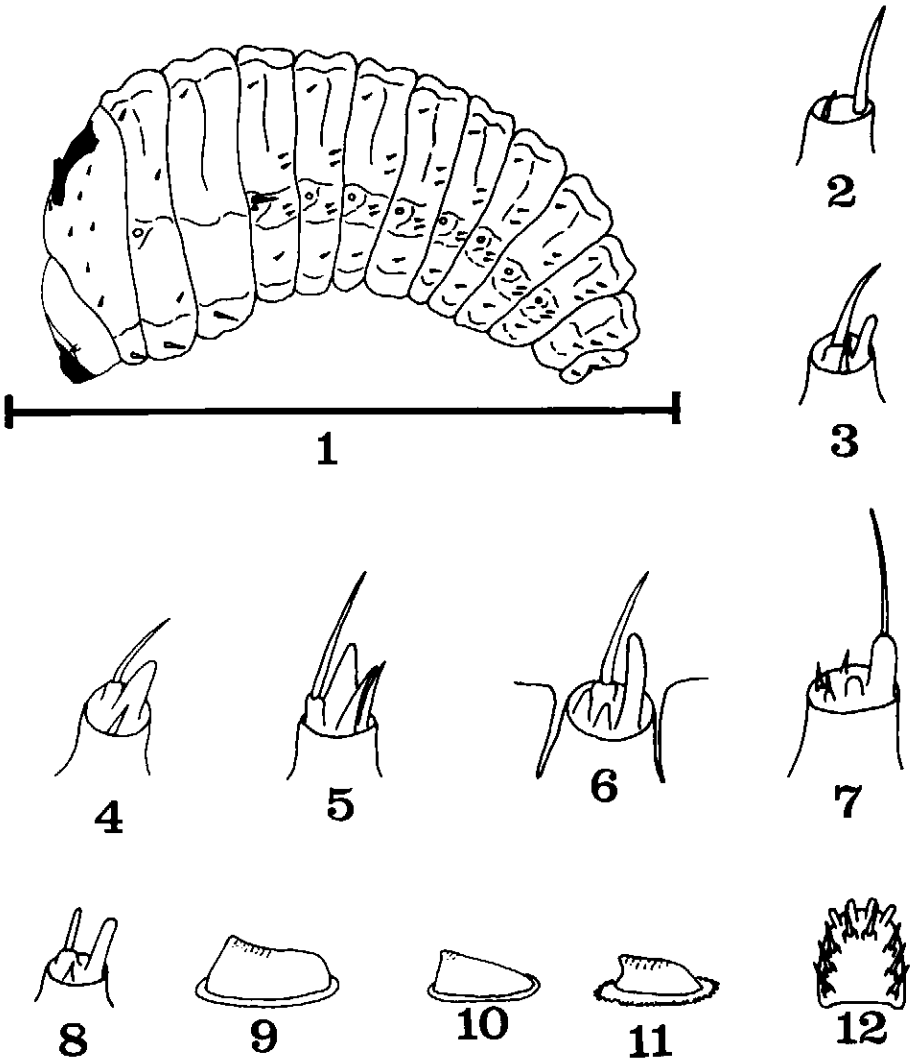
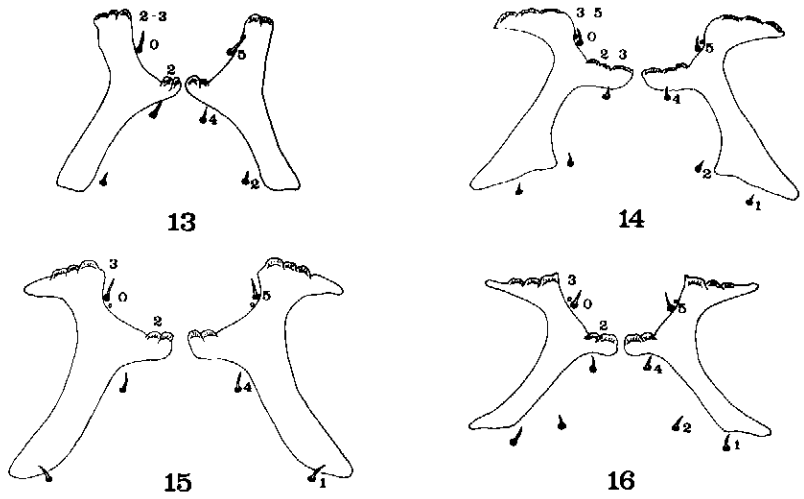


Fig. 1. General first instar habitus of *Stator* larvae. Scale line=1.0 mm. Figs. 2-8, antennae of; *S. chihuahua, generalis, limbatus, pruininus, pygidialis, sordidus* and *vachelliae,* respectively. Figs. 9-11, egg choria of; *S. generalis, sordidus* and *vachelliae,* respectively. Fig. 12, labrum of *S. generalis.*



Figs. 13-16. Prothoracic plates of S. chihuahua, generalis, sordidus and *vachelliae,* respectively.

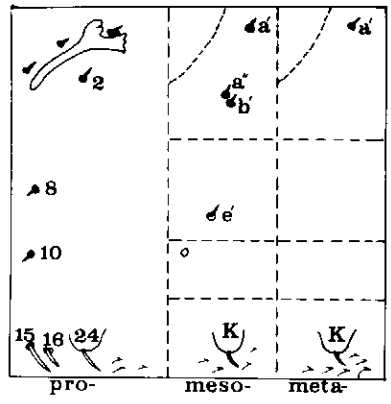
regions. *Prothoracic plate:* (Fig. 13) X or H-shaped; lacking antero- and posterolateral extensions (cf. Figs. 13 and 14; with at least 4 pairs of teeth; teeth arranged in 2 + 0 + 2 - 3 formula (see Fig. 15 A in Prevett 1971); with 3 pairs of setae (identified by numbers along right half of plate); setae pair 2 bordering antero-medial margin of plate; setal pair 4 anterior to medial arm of plate; setal pair 5 along medial border midway between medial and posterior arms of plate. *Prothorax:* (Fig. 17, Table 1) with 5 pairs of setae, exempting those associated with prothoracic plate and proleg (seta 24); few, sclerotized projections along posterior border of sternum. *Mesothorax* and *metathorax:* (Fig. 17, Table 1) prodorsum bare; meso-postdorsum with 3 setae (a′, a′′, b′); meta-postdorsum with a′; epipleural regions bare excepting seta e′ on mesoepipleuron; hypopleural regions asetiferous, spiracle in meso-hypopleural region; sternum with numerous, sharp, posteriorly directed, sclerotized projections. *Legs:* (Fig. 17) unisetiferous, prolegs. *ABDOMEN:* (Fig. 21, Table 1) prodorsa 1-8 with one seta (d′), ninth prodorsum bare; postdorsa 1-9 with setae a′′ and b′, seta a′ present on ninth postdorsum; spiracular areas asetiferous; elongate, sclerotized spine present on spiracular area of first segment; epipleural regions asetiferous; hypopleural regions 1-9 unisetiferous (h), seta (h) absent on 10th segment; sternites 3-9 with sharp, sclerotized projections; seta *g* present on button-like 10th segment. *Anus:* transverse.

EGG: unavailable.

Specimens examined: 15; determined by association with reared adults.

Host plants: *Acacia angustissima* (Mill.) Kuntze. For locality see CDJ #221-76 (Johnson 1979).

Significant characters include: absence of primary setae; 2-3 teeth on the posterior arms of the prothoracic plate; absence of antero- and postero-lateral extensions of the plate; the absence of a subtending sensory pore with seta 5 on the prothoracic plate; the absence of seta 1 at the antero-lateral angle of the prothoracic plate; the presence of unisetiferous prolegs on the thorax; absence of a sensillum basiconicum on antenna; presence of pointed, sclerotized, projections on abdominal sternites 3-9 and absence of setae on all abdominal sternites; presence of prodorsal setae on abdominal segments 1-8 with the combined absence of setae in the spiracular and epipleural regions.



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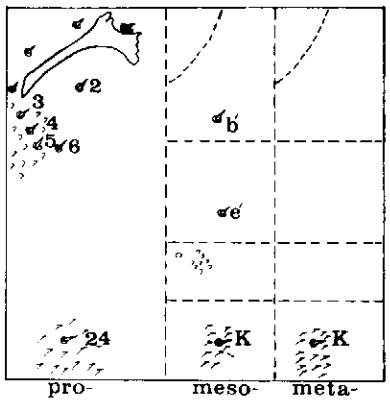

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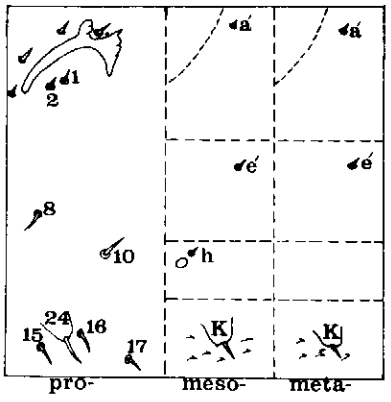

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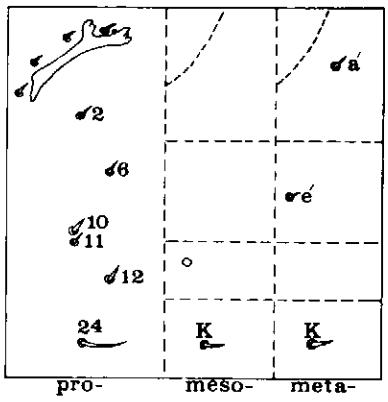

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Figs. 17-20. Thoracic chaetotaxy of *S. chihuahua, generalis, sordidus* and *vachelliae,* respectively.

Stator generalis Johnson and Kingsolver

For discussion of body and head characters see description of *S. chihuahua. Labrum:* (Fig. 12) (cf. Fig. 23, Q in Pfaffenberger and Johnson 1976) elongate with parallel sides and rounded anterior end; four, short, stout, obtuse setae arranged in arc near anterior end; eight, short, sharp setae, on elevated bases; 3 bordering each parallel side of labrum and 2 centrally located behind obtuse setae. *Antenna:* (Fig. 3) for location refer to *S. chihuahua;* single segmented; retractable (Fig. 6); with 2 distal setae and sensillum basiconicum; one seta 2-3 times longer than other; sensillum half as long as elongate seta. *THORAX:* (Fig. 18) refer to *S. chihuahua. Prothoracic plate:* (Fig. 14) with at least 5 pairs of teeth; teeth arranged in 2 - 3 + 0 + 3 - 5 for-

mula (see *S. chihuahua);* with 4 pairs of setae identified as setae 1, 2, 4, and 5); seta with subtending sensory pore and located midway between medial and posterior arms; seta 4 anterior to medial arms; seta 2 near point of medial curvature of anterior arms; seta 1 located midway along oblique, cephalic angle of anterior arm. *Prothorax:* (Fig. 18, Table 2) with 5 pairs of setae, exempting those associated with prothoracic plate and appendage (Seta 24); setae 3-6 interspersed among numerous, non-sclerotized, integumental protrusions; seta 24 a functional appendage and situated among many posteriorly directed, sharp, sclerotized projections. *Mesothorax* and *metathorax:* (Fig. 18, Table 2) prodorsa asetiferous; meso-postdorsum and meso-epipleuron unisetiferous, with setae b′ and e′ respectively; meso-hypopleuron with small cluster of minute, integumental protrusions near spiracle; metathoracic segment asetiferous (excepting sternite); sternites of both with seta *K,* as appendage; seta *K* surrounded by numerous posteriorly directed, sharp, sclerotized projections. *Legs:* (Fig. 18) absent. *ABDOMEN:* (Fig. 22, Table 2) prodorsa 1-8 unisetiferous (d′); ninth prodorsum asetiferous (a′′); postdorsa 2-9 bisetiferous (a′′b′); postdorsa 5-9 with numerous, randomly distributed, fleshly, protrusions; spiracular area, of segment 1, with single seta (s′) and elongate, blunt spine; remaining spiracular areas asetiferous; spiracles 5-8 surrounded by small, fleshy, protrusions, epipleurites 1-4 and 9 unisetiferous (e′); epipleurites 5-8 bisetiferous (e′e′′); hypopleurites 1-10 unisetiferous (h); sternites 1-9 unisetiferous (v); seta *v* surrounded by numerous, posteriorly directed, sharp, sclerotized projections; tenth tergite with seta *g* and asetiferous sternite. *Anus:* transverse.

Table 1. Distribution of setae on Stator chihuahua, first instar.

Segment	Pro-dorsum	Post-dorsum	Spiracular area	Epi-pleuron	Hypo-pleuron	Sternum	Pro-thorax
Mesothorax		a'a"b'		c'		K	2
Metathorax		a'				K	8
Abdomen							10
1	d'	a"b'			h		15
2	d'	a"b'			h		16
3-5	d'	a"b'			h		24
6-8	d'	a"b'			h		
9		a'a"b'			h		
10 g							

Table 2. Distribution of setae on Stator generalis, first instar.

Segment	Pro-dorsum	Post-dorsum	Spiracular area	Epi-pleuron	Hypo-pleuron	Sternum	Pro-thorax
Mesothorax		b'		e'		K	2
Metathorax						K	3
Abdomen							4
1	d'	a"	s'	e'	h	v	5
2-3	d'	a"b'		e'	h	v	6
4	d'	a"b'		e'	h	v	24
5-8	d'	a"b'		e'e"	h	v	
9		a"b'		e'	h	v	
10 g							

EGG: (Fig. 9) with anterodorsal point and smooth, broad band of mucilage. Emergence is anteroventral.

Specimens examined: 31; determined by association with reared adults.

Host plants: *Enterolobium cyclocarpum* (Jacq.) Griseb.: Panama Viejo, Panama, Pan., Panama, 26 March 1979. Collected by C. D. Johnson.

Significant characters include: absence of primary setae; antenna with sensillum basiconicum half as long as elongate primary seta; absence of thoracic prolegs; asetiferous metathorax (excepting sternite); prothoracic plate with 2-3 teeth on median arms and 3-5 teeth on posterior arms; fleshy protrusions on abdominal postdorsa 5-9 and spiracular areas 5-8 papillose; abdominal epipleurites 1-4 and 9 unisetiferous and 5-8 bisetiferous; presence of seta *h* on segment 10; sternites 1-9 with seta *v*, the latter surrounded by numerous posteriorly directed, sharp, sclerotized projections.

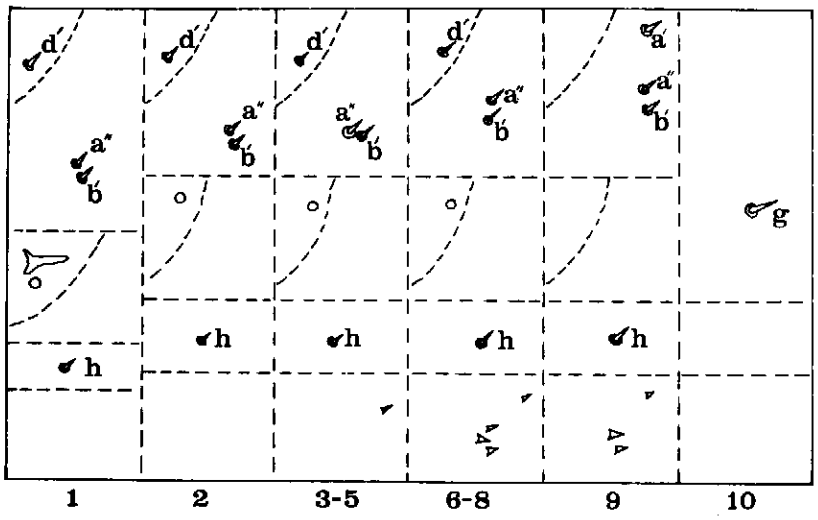
Stator sordidus (Horn)

For discussion of the body and head characters see description of *S. chihuahua*. *Antenna:* (Fig. 7) for location refer to *S. chihuahua;* single segmented; retractable (Fig. 6); apical end dominated by single, elongate seta supported on papilla-like base; seta more than twice as long as base; small, dome-shaped, sensory structure near setal base; opposite side of apical end bordered by 3 equidistantly spaced, short, sharp, sensory setae. *THORAX:* (Fig. 19) refer to discussion of *S. chihuahua. Prothoracic plate:* (Fig. 15) with 5 pairs of teeth; teeth arranged in 2 + 0 + 3 formula (see *S. chihuahua);* with 3 pairs of setae (identified as 1, 4, and 5). *Prothorax:* (Fig. 19, Table 3) with 7 pairs of setae, excluding those associated with prothoracic plate and proleg (seta 24). *Mesothorax* and *metathorax:* (Fig. 19, Table 3) prodorsa asetiferous; postdorsa and epipleurites unisetiferous with setae a′ and e′ respectively; mesohypopleuron with seta *h* and spiracle; metahypopleuron asetiferous; sternites with seta *K* on prolegs; sternites with randomly arranged, posteriorly directed, sharp, sclerotized projections. *ABDOMEN:* (Fig. 23, Table 3) prodorsa 6-9 unisetiferous (d′), other asetiferous; first postdorsum unisetiferous (a′′); postdorsa 2-9 bisetiferous (a′′b′); spiracular area, of segment 1, with single seta (s′) and elongate, blunt spine; remaining spiracular areas asetiferous; epipleurites asetiferous; hypopleurites 1-9 unisetiferous (h); sternites 2-9 with anterolateral seta *u;* seta *v* present on sternite 1; sternites 8-9 with 4 cubically arranged, sharp, sclerotized projections; segment 10 with laterally located seta *g*, hypopleurite and sternite asetiferous. *Anus:* transverse.

EGG: (Fig. 10) dorsum more or less straight and angled downward from anterior to posterior end; secured by flat, narrow band of mucilage. Emergence appears to be unique in that the entire ventral surface is split lengthwise. The typical emergence hole was not observed.

Table 3. Distribution of setae on Stator sordidus, first instar.

Segment	Pro-dorsum	Post-dorsum	Spiracular area	Epi-pleuron	Hypo-pleuron	Sternum	Pro-thorax
Mesothorax		a'		e'	h	K	1
Metathorax		a'		e'		K	2
Abdomen							8
1		a"	s'		h	v	10
2-5		a"b'			h	u	15
6	d'	a"b'			h	u	16
7	d'	a"b'			h	u	17
8-9	d'	a"b'			h	u	24
10	g						



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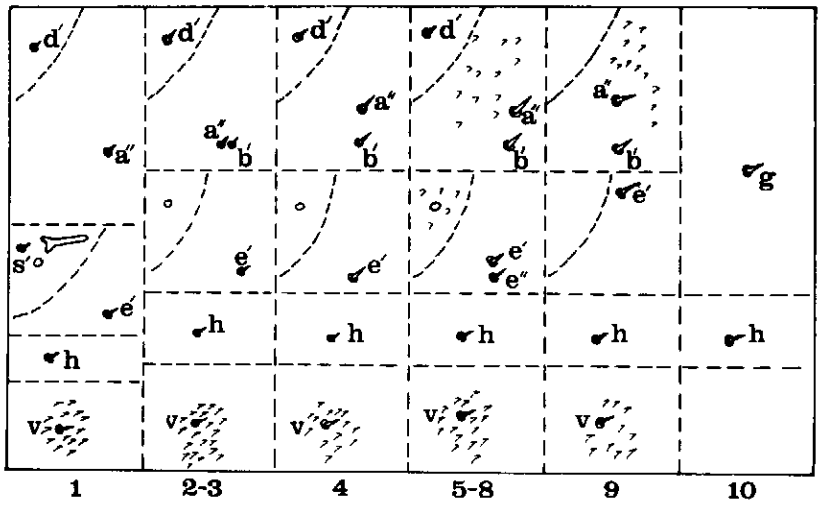

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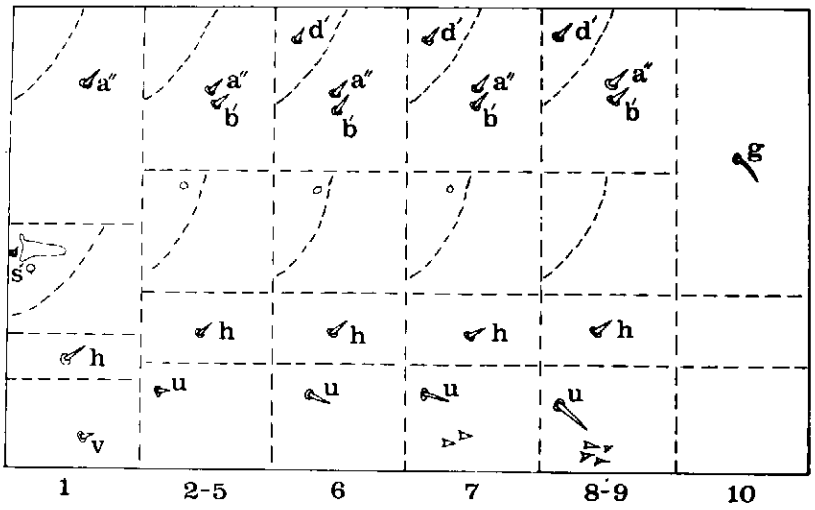
Figs. 21-22. Lateral view of abdomen, showing chaetotaxy. *S. sordidus* and *vachelliae,* respectively.



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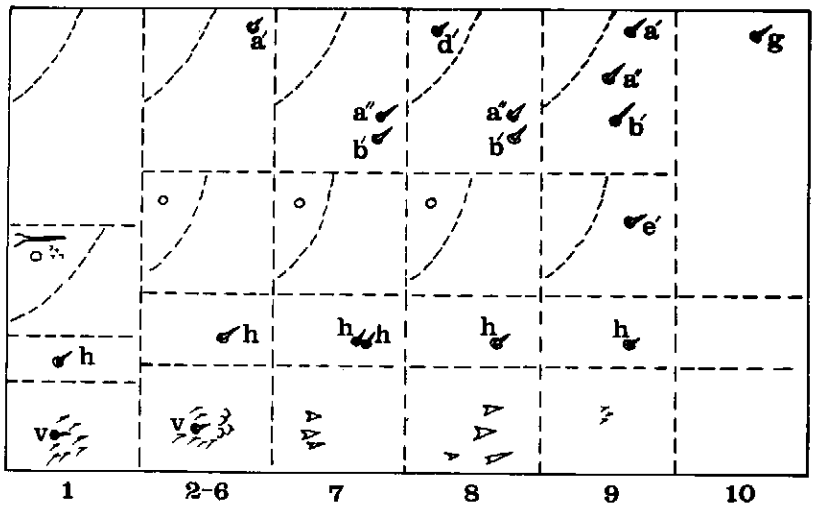

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Figs. 23-24. Lateral view of abdomen, showing chaetotaxy. *S. sordidus* and *vachelliae*, respectively.

Specimens examined: 14; determined by association with reared adults.

Host plants: *Lysiloma divaricata* (Jacq.) Macbride. For locality see CDJ # 203-76 (Johnson 1979).

Significant characters include: absence of primary setae; antenna with 3 short, sharp, sensory setae and also supporting elongate seta on papilla-like base and dome-like sensory structure; unisetiferous meso- and metepipleurites; unisetiferous mesohypopleuron; sternites 2-9 with seta *u* and posteriorly directed, sharp, sclerotized projections on sternites 7-9.

Stator vachelliae Bottimer

For discussion of body and head characters see description of *S. chihuahua. Antenna:* (Fig. 8) for location refer to *S. chihuahua;* single segmented; retractable (Fig. 6); apical end with obtuse seta on elevated base, length equal to elongate, obtuse sensillum basiconicum; sharp, spine-like process near base of elevated, obtuse seta. *THORAX:* (Fig. 20, Table 4) refer to discussion of *S. chihuahua. Prothoracic plate:* (Fig. 16) posterior arm with pointed median tooth; teeth similar to S. sordidus; setae similar to *S. generalis. Prothorax:* (Fig. 20, Table 4) with 5 pairs of setae, excluding those associated with prothoracic plate and appendage (seta 24). *Mesothorax* and *metathorax:* (Fig. 20, Table 4) mesothorax asetiferous, excepting sternite with seta *K;* metathorax with asetiferous prodorsum and hypopleuron, unisetiferous postdorsum (a′) and epipleuron (e′); metasternite with seta *K. ABDOMEN:* (Fig. 24, Table 4) prodorsum 8 unisetiferous (d′), other prodorsa asetiferous; first postdorsum asetiferous; postdorsa 2-6 unisetiferous (a′); postdorsa 7-8 bisetiferous (a′′b′); ninth postdorsum trisetiferous (a′a′′b′); first spiracular area with unusually narrow, pointed spine, and slightly papillose; all spiracular areas asetiferous; epipleurites 1-8 asetiferous; ninth epipleurite unisetiferous (e′); hypopleurites 1-6 and 8-9 unisetiferous (h); seventh hypopleruite bisetiferous (hh); tenth hypopleurite asetiferous; sternites 1-6 with seta *v* and numerous, posteriorly directed, sharp, sclerotized projections; sternites 2-6 with unique bracket-shaped, sclerotized projections posterior to seta *v;* sternites 7-10 asetiferous; ninth sternite with minute, sclerotized projections. *Anus:* transverse.

EGG: (Fig. 11) dorsum more or less parallel with base; prominent anterodorsal point; secured by a broad band of mucilage whose edge is uniquely serrated. Emergence occurs antero-ventrally.

Specimens examined: 15; determined by association with reared adults.

Host plants: *Acacia cymbispina* Sprague and Riley. For locality see CDJ #197-76 (Johnson 1979).

Significant characters include: Elevated, obtuse antennal seta and associated obtuse, elongate sensillum basiconicum; pointed median tooth on posterior arm of prothoracic plate; asetiferous dorsal, epipleural and hypopleural regions of mesothorax;

Table 4. Distribution of setae on Stator vachelliae, first instar.

Segment	Pro-dorsum	Post-dorsum	Spiracular area	Epi-pleuron	Hypo-pleuron	Sternum	Pro-thorax
Mesothorax						K	2
Metathorax		a'		e'		K	6
Abdomen							10
1					h	v	11
2-6		a'			h	v	12
7		a"b'			hh		24
8	d'	a"b'			h		
9		a'a"b'		e'	h		
10	g						

spine on first abdominal segment elongate, narrow and pointed; bracket-shaped, sclerotized projections on sternites 2-6; bisetiferous hypopleuron of segment 7; enlarged, pigmented, sclerotized projections on sternites of segments 7-8.

Stator limbatus (Horn)

Antenna: (Fig. 4) single segmented; retractable (Fig. 6); with 2 setae and large, cone-shaped sensillum basiconicum; elongate seta 2 to 3 times as long as short setae and supported on papilla-like base; short and elongate setae on opposite side of sensillum; sensillum nearly as long as elongate seta. For additional information of taxonomic importance see Pfaffenberger and Johnson (1976).

Stator pruininus (Horn)

Antenna: (Fig. 5) single segmented; retractable (Fig. 6); apical end dominated by enlarged, centrally located, cone-shaped sensillum; single elongate seta supported on papilla-like base; 2 sharp, stout, sensory setae bordering base of sensillum; paired setae ¾ as long as sensillum and half as long as elongate setae. For additional information of taxonomic importance see Pfaffenberger and Johnson (1976).

Stator pygidialis (Schaeffer)

Antenna: (Fig. 6) single segmented; retractable; with 3 sensilla and one elongate seta; one greatly elongate, narrow, sensillum nearly as long as elongate seta; both seta and sensillum as long as segment; 2 small, cone-shaped sensilla slightly longer than papillary base of elongate seta. For additional information of taxonomic importance see Pfaffenberger and Johnson (1976).

KEY TO SOME *Stator* FIRST INSTAR LARVAE

[For reference to figures mentioned in couplets 1-3 see Pfaffenberger and Johnson (1976)].

1. Median tooth on posterior arm of prothoracic plate elongate (Fig. 22,S), slender and pointed 2
1′. Posterior arms of prothoracic plate lacking elongate, pointed, median tooth 4

2(1). Posterior arm of prothoracic plate with 5 teeth (Fig. 22,Q); seta *d* absent on abdominal prodorsa 1-7 (Fig. 40) . . . . . *S. limbatus* (Horn)
2′. Posterior arm of prothoracic plate with 3 teeth (Fig. 22, R); seta *d* present on abdominal prodorsa 1-7 3

3(2′). Large, pigmented, sclerotized projections on abdominal sternites 7 and 8 (Fig. 41); right median arm, of prothoracic plate, with 2 teeth, left median arm with 1 tooth (Fig. 22, R); meso- and metahypopleura unisetiferous (Fig. 19); thoracic appendages absent, replaced by seta . . . . . *S. pruininus* (Horn)
3′. Abdominal sternites 7 and 8 lacking pigmented projections (Fig. 42); each median arm, of prothoracic plate, with 2 teeth; meso- and metahypopleura asetiferous; thoracic appendages replaced by prolegs (Fig. 20); cuticular projections along posterior border of first abdominal epipleuron (Fig. 42) . . . . . *S. pygidialis* (Schaeffer)

4(1′). Prothoracic plate with 3 pairs of associated setae (Fig. 13); thoracic appendages replaced by prolegs, each of which bears a terminal seta (Fig. 17) 5

4′. Prothoracic plate with 4 pairs of associated setae (Fig. 14); thoracic appendages replaced by seta, prolegs absent (Fig. 18) 6

5(4). Antero- and posterolateral extensions of prothoracic plate absent (Fig. 13); posterior arms with 2 teeth on left arm and 3 teeth on right arm; prothoracic plate bordered, mid-laterally, by one seta (Fig. 13); metathoracic epipleuron asetiferous (Fig. 17); apical end of antenna with 2 setae, one 4 to 5 times as long as the other (Fig. 2) ..... *S. chihuahua* Johnson and Kingsolver

5′. Antero- and posterolateral extensions of prothoracic plate present (Fig. 15); each posterior arm of prothoracic plate with 3 teeth; prothoracic plate bordered, mid-laterally, by 2 setae (Fig. 19); apical end of antenna (Fig. 7) with single, elongate seta supported by noticeably elongate, papilla-like base; several smaller setae and small dome-shaped sensillum also present ..... *S. sordidus* (Horn)

6(4′). Median arms, of prothoracic plate, with 2 or 3 teeth while posterior arms have 3 to 5 teeth (Fig. 14); prothoracic setae clustered near anterolateral borders of plate among numerous, integumental projections (Fig. 18); mesothoracic spiracle bordered posteriorly by small, integumental projections; sternites with numerous, sharp, posteriorly directed projections; spiracular area on first abdominal segment unisetiferous (Fig. 22); tenth abdominal segment with two pairs of setae (Fig. 22); abdominal epipleurites 1-4 unisetiferous and 5-8 bisetiferous ..... *S. generalis* Johnson and Kingsolver

6′. Median arms, of prothoracic plate (Fig. 16) with 2 teeth while posterior arms have 3 teeth; median tooth of posterior arms slightly pointed; prothoracic setae not clustered but distributed at random (Fig. 20); prothoracic sternites lacking projections (cf. Figs. 18 and 20); bracket-shaped, sclerotized projections of abdominal sternites 2-6 (Fig. 24) enlarged, pigmented, sclerotized projections on abdominal sternites 7 and 8; tenth abdominal segment with one pair of setae ..... *S. vachelliae* Bottimer

Comparison Between Adult Intuitive and Larval Numerical Classifications

Johnson and Kingsolver (1976) published a phylogenetic grouping of *Stator* species found in North and Central America. Their intuitive assemblage consisted of six groups representing 18 species. Although only 7 larval descriptions are available for members of this genus, three of their six suggested groups are represented by described larvae. These groups are the Aegrotus, Limbatus and Sordidus groups. In the present larval study, the Aegrotus group is represented by *S. pruininus*, the Limbatus group by

S. generalis and *S. limbatus*, and the Sordidus group by *S. chihuahua*, *S. pygidialis*, *S. sordidus*, and *S. vachelliae*.

To determine the credibility of their weighted arrangement and to test the congruency of it with a numerical larval classification scheme, a principal component analysis (PCA) was run. The variables used are listed in table 5, and the results of the PCA are listed in table 6. As seen in table 6, the eigen value of the "first centroid factor" (Sokal and Sneath 1963) accounts for over half (39% of 75%) of the cumulative proportion of the total variance among the operational taxonomic units (OTU). From table 6, it can also be seen that the second and third centroid factors account for 19.5% and 16% of the variation, respectively. Thus, three centroid factors account for 75% of the possible variation among the OTU's. The eigenvalues and corresponding eigenvectors, of the three centroid factors, are illustrated in the three component plot shown in figure 25.

Three separate larval taxonomic groups exist (Fig. 25), thereby supporting the groups of Johnson and Kingsolver (1976). OTU's 2 and 3, from the three component plot, represent a clustered duo of *S. generalis* and *S. limbatus*. Both share the following traits: five teeth on the posterior arms of the prothoracic plate: four setal pairs associated with the plate; equivalent numbers of setae on the ninth abdominal postdorsum and tenth abdominal segment; one setal pair on the first abdominal sternite; two setae on each eighth abdominal epipleurite; absence of setae on the meso- and metathoracic hypopleura. Such an arrangement as in agreement with Johnson and Kingsolver (1976; Table 4).

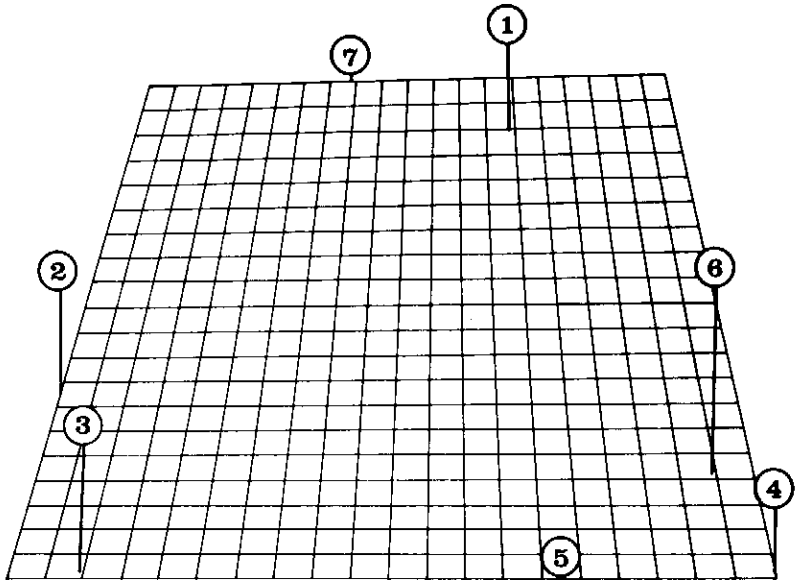

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Fig. 25. Three component plot, of principal component analysis, showing phenetic relationships among first instar larvae.

A second closely related pair (Fig. 25) are *S. chihuahua* and *S. vachelliae.* Both species are unique with respect to the following combination of characters: six pair of prothoracic setae; one pair of setae on the tenth abdominal segment; three pair of setae on the ninth abdominal postdorsum; absence of setae on the meso- and metathoracic hypopleura, on the first abdominal spiracular area and eighth abdominal epipleurites; presence of two pairs of setae on eighth abdominal postdorsum.

The remaining species *(S. pruininus, S. pygidialis, S. sordidus)* were lumped in the same group. These species, though less cohesive, share the following set of exclusive characters: three teeth on posterior arms of prothoracic plate; two pairs of setae on abdominal postdorsa 3-5; one seta on each first, abdominal spiracular area; one setal pair on prodorsa of seventh abdominal segment.

The second and third groups, mentioned above, deviate somewhat from the Aegrotus and Sordidus groups (Table 4; Johnson and Kingsolver 1976). In the three component plot (Fig. 25), OTU's 1 *(S. chihuahua)* and 7 *(S. vachelliae)* are distinctly isolated from the other two clusters of OTU's. This phenetic relationship supports the placement of *S. chihuahua* and *S. vachelliae* in a group separate from the remaining three species.

Additional incongruency arises among the remaining three species *(S. pruininus, S. pygidialis, S. sordidus). S. pruininus* (4th OTU in Fig. 25) is the only member involved in this study which was placed in a separate phylogenetic group by Johnson and Kingsolver (Table 4; 1976). When the variables (Table 5) for each OTU are analyzed, it appears as though cophenetic values are much higher between OTU's 4 and 5 than between either of the other possible combinations (4 and 6 or 5 and 6). Consequently, this supports splitting the Sordidus group and lumping OTU's 4, 5 and 6 in a separate phylogenetic group.

On the basis of larval chaetotaxy, plate morphology and presence or absence of legs, this arrangement appears to be acceptable until one examines antennal structure. By doing so, complete congruency prevails for the Limbatus group *(S. generalis, S. limbatus)* while incongruency permeates the remaining two groups.

TABLE 5. Variables used in the principal component analysis.

1. Number of teeth on median arm of prothoracic plate.
2. Number of teeth on posterior arm of prothoracic plate.
3. Number of setal pairs associated with the prothoracic plate.
4. Number of segments in leg.
5. Number of setae on mesothoracic epipleuron.
6. Number of prothoracic setae.
7. Number of setae on postdorsum of abdominal segments 3-5.
8. Number of setae on tenth abdominal segment.
9. Number of setae on ninth abdominal postdorsum.
10. Number of setae on first abdominal spiracular area.
11. Number of setae on first abdominal sternite.
12. Number of setae on second abdominal prodorsum.
13. Number of setae on eighth abdominal epipleurites.
14. Number of setae on metathoracic sternite.
15. Number of setae on metathoracic hypopleura.

TABLE 6. Results of Principal Component Analysis.

Eigenvalues	Cumulative Proportion (%) of Total Variance
1. 7.03187	1. 39.07
2. 3.41008	2. 58.57
3. 2.88059	3. 74.57

Eigenvectors	1	2	3
Chihuahu	0.697	0.157	0.015
Generali	-0.053	-0.611	0.103
Limbatus	-0.586	-0.506	0.294
Pruininu	-0.590	0.507	-0.099
Pygidial	-0.605	0.194	-0.498
Sordidus	0.295	0.436	0.634
Vachelli	0.842	-0.178	-0.450

In conclusion, most of the variables used in this numerical analysis were adopted from Pfaffenberger and Johnson (1976). Therefore, when comparisons are made between figure 25, and their three component plot it can be seen that affinities between OTU's 17, 18 and 19 (Fig. 44; Pfaffenberger and Johnson 1976) are greatly exaggerated when compared to the same OTU's (3,4 and 5) in figure 25. It can be assumed, therefore, that this genus represents a well conceived, homogeneous group of organisms. As a result of the apparent phenotypic heterogeneity among OTU's 1, 4, 5, 6 and 7 (Fig. 25), it is recommended that larvae of additional species be studied before support can or cannot be provided for the phylogenetic groupings presented by Johnson and Kingsolver (1976).

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