FIRST RECORDS OF THE SUGAR CANE AND FORAGE GRASS PEST, *PROSAPIA SIMULANS* (HOMOPTERA: CERCOPIDAE), FROM SOUTH AMERICA

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ABSTRACT

The genus *Prosapia* Fennah and *P. simulans* (Walker) are reported for the first time in South America, based on recent field collections in Colombia and museum specimens from Venezuela. *Prosapia simulans* was found on *Axonopus micay* García-Barr., *Brachiaria decumbens* Stapf, *B. dictyoneura* (Fig. & De Not.) Stapf, *Cynodon plectostachyus* (K. Schum.) Pilger, *Hyparrhenia rufa* (Nees) Stapf and *Saccharum officinarum* L. (Poaceae). Persistent field populations were detected from 1060-1621 m elevation, principally associated with *B. decumbens*, reaching economic levels in one of the observed sites. On two occasions *P. simulans* was found on sugar cane. Evidence suggests that this Central American sugar cane and forage grass pest is a well-established new arrival, thereby representing a new threat to pasture production and potential threat to cane production in Colombia's Cauca Valley. The distribution, bionomics, and pest status of *P. simulans* are summarized, and its mode of introduction and potential pest status are discussed.

Key Words: *Brachiaria decumbens*, Colombia, forage pest, new detection, *Prosapia simulans*, *Saccharum officinarum*, spittlebug

RESUMEN

El género *Prosapia* Fennah y *P. simulans* (Walker) son reportados por primera vez en Suramérica, basado en recolecciones recientes del campo en Colombia y especímenes de museo de Venezuela. *Prosapia simulans* fue encontrado en *Axonopus micay* García-Barr., *Brachiaria decumbens* Stapf, *B. dictyoneura* (Fig. & De Not.) Stapf, *Cynodon plectostachyus* (K. Schum.) Pilger, *Hyparrhenia rufa* (Nees) Stapf y *Saccharum officinarum* L. (Poaceae). Poblaciones persistentes en campo fueron detectadas desde 1060-1621 msnm, principalmente asociada con *B. decumbens*, alcanzando niveles económicos en uno de los sitios observados. En dos ocasiones *P. simulans* fue encontrado sobre caña de azúcar. La evidencia sugiere que esta plaga centroamericana de caña de azúcar y gramíneas forrajeras es una nueva llegada bien establecida, representando así una nueva amenaza para la producción de pastos y una amenaza potencial para la producción de caña en el Valle del Cauca en Colombia. Se resume la distribución, las bionómicas, y el estado de plaga de *P. simulans,* y se discute su modo de introducción y estado de plaga potencial.

Grassland spittlebugs (Homoptera: Cercopidae) are native xylem-feeding insects that are broadly distributed and damaging pests of graminoid crops in the Neotropics. Major hosts include sugar cane (*Saccharum officinarum* L.) and forage grasses, particularly the widely sown and highly susceptible *Brachiaria decumbens* Stapf. This diverse group of spittlebugs, which includes dozens of species from at least 11 genera, poses a major limitation to productivity and persistence of the most extensive agricultural activity in the Neotropics, pastures for the production of forage, milk and beef.

The most widely distributed species in this pest complex is *Prosapia simulans* (Walker), occurring in the lowland tropics from Mexico to Panama (Hamilton 1977). To our knowledge, this species and the genus *Prosapia* Fennah have never been reported in South America. Herein we report the first field detection of *P. simulans* in Colombia, and an additional record from museum specimens collected in Venezuela. Quantitative measures of field abundance were performed to make a preliminary assessment of population density and persistence. We summarize the literature on its geographic distribution, bionomics and pest status; provide diagnostic characters to distinguish it from other grassland spittlebugs in northern South America; and discuss its possible mode of introduction and pest status potential.

FIELD DETECTION

We discovered populations of *P. simulans* on six farms in the Cauca Valley of Colombia in 1999-2000. All specimens were identified using characteristics of the male genitalia and compared with type specimens at the Natural History Museum (BMNH), London.

The first report was obtained 2-VI-1999 when a single female was captured in the course of weekly surveys to document population fluctuations of the common local spittlebug species *Zulia* *carbonaria* (Lallemand) in *Brachiaria dictyoneura* (Fig. & De Not.) Stapf (population 1, Hacienda Las Palmas, 3.050°N, 76.498°W) (Table 1, Fig. 1). Additional surveys in surrounding pastures and sugar cane fields, and weekly surveys in the same site over the following year, did not recover more individuals.

On 2-VII-1999 a large population was discovered approximately 94 km northeast in a pasture of *B. decumbens* at 1155 m elev. (population 2, Finca El Mirador del Paraíso, 3.650°N, 76.240°W) (Table 1, Fig. 1). On that visit *P. simulans* was the only spittlebug species present, with abundant adults and nymphs (unmeasured). A follow-up visit to the same pasture on 4-IV-2000 verified a continued presence at greater abundance than the first visit, measured at 46.8 nymphs/m^2 (n = 10 0.25m^2 quadrats) and 190 adults/50 sweeps (n = 4 series of 50 sweeps). In the second and third visits, *Z. carbonaria* and *Zulia pubescens* (F.) were also detected. Although economic thresholds based on quantitative yield loss data have never been established for grassland spittlebugs, these levels are considered highly damaging in forage grasses of Mexico. Padilla and Esquiliano (1966) designate >30 nymphs/m^2 and >25 adults/50 sweeps as "severe" while Velasco & Sifuentes (1970) designate >46 nymphs/m^2 and >150 adults/50 sweeps as "high" infestations.

Subsequent to the detection of this large population, four additional populations were detected between 1100 and 1621 m elevation, ranging from the valley floor to just over the top of the western cordillera of the Andes (Table 1, Fig. 1). These populations were persistent because the insect was detected over a few to several months.

In population 3 (Finca Canadá, 3.849°N, 76.466°W), *P. simulans* were detected along with *Z. carbonaria* and *Z. pubescens* in five upland pastures of *B. decumbens* and *Cynodon plectostachyus* (K. Schum.) Pilger. In the second visit, various *P. simulans* adults were found feeding on sugar cane (*S. officinarum*) but nymphs were absent. In populations 4 (Finca La María, 3.940°N, 76.438°W) and 5 (Finca La Albania, 3.950°N, 76.453°W) the insect was detected along with *Z. carbonaria* and *Z. pubescens* in three upland pastures of *B. decumbens*. Additional hosts in population 5 included *Axonopus micay* García-Barr., *C. plectostachyus* and *Hyparrhenia rufa* (Nees) Stapf. In population 6, *P. simulans* were detected along with *Z. carbonaria* and *Z. pubescens* in four lowland pastures of *B. decumbens* (Hacienda Piedechinche, 3.373°N, 76.142°W). On a separate occasion, a single nymph was observed in a spittle mass at the base of the leaf whorl on sugar cane; at the time only *P. simulans* adults were found on nearby weeds and grass (L.A. Lastra, CENICAÑA, pers. comm.).

Voucher specimens of *P. simulans* from all six populations were deposited in the Cornell University Insect Collection under Lot #1227.

Additional South American Records

A series of *P. simulans* was identified in the insect collection of the Centro Internacional de Agricultural Tropical (CIAT), Cali, Colombia (2 specimens) and BMNH (7 specimens). This material was all collected on 30-V-1980 by Gerardo Pérez Nieto from Venezuela, Bolivar State, La Vergareña, in pasture, calculated to be near 6.783°N, 63.559°W (Fig. 1). No other South American specimens were found in the collections at BMNH, Cornell University, the Universidad Nacional in Palmira or the Universidad del Valle in Cali (Dept. Valle del Cauca).

Distribution, Pest Status and Bionomics

The genus *Prosapia* comprises 14 species and ranges from Ontario, Canada to Panama (Hamilton 1977). Two new species from Costa Rica are being described (V. Thompson, Roosevelt University, pers. comm.). *Prosapia simulans* is widespread in the lowland tropics (Fig. 1). It is reported in nine Mexican states (Chiapas, Guerrero, Nuevo León, Oaxaca, Querétaro, San Luis Potosí, Tabasco, Tamaulipas, Vera Cruz), within 70 miles of the United States border (Fennah 1953; Clark et al. 1976; Agostini et al. 1981), and throughout Central America (Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panama) (Metcalf 1961; D.P., personal observation of specimens at BMNH). Although Guagliumi (1955) lists *P. simulans* in Colombia, the report is unsubstantiated and is probably in error.

Prosapia simulans attacks many of the major forage grass species in this geographic range, including *Cenchrus ciliaris* L. (Enkerlin & Morales 1979), *Cynodon nlemfuensis* Vanderyst (Peck 1999), *Digitaria decumbens* Stent (Oomen 1975), *Paspalum notatum* Fluggé (V. Thompson, pers. comm.), *S. officinarum* (Box 1953, Oomen 1975), and *Zea mays* L. (Ballou 1936). Four additional host species in greenhouse studies are *Avena sativa* L., *Pennisetum glaucum* (L.) R. Br., *Setaria italica* (L.) P. Beauv. and *Sorghum* sp. (Enkerlin & Schwartz 1979). The only non-graminoid host (adults only) reported is the tree *Ilex haberi* (Aquifoliaceae) (Peck 1998a).

Enkerlin & Morales (1979) also add the following hosts (citing Flores et al. 1965 and Velasco 1968) but do not specify if they are particular to *P. simulans* or the sympatric *Aeneolamia albofasciata* (Lallemand): *Chloris gayana* Kunth, *Cynodon plectostachyus* (K. Schum.) Pilger, *Cynodon dactylon* (L.) Pers., *Echinochloa polystachya* (Kunth) Hitchc., *H. rufa*, *Panicum purpurascens* Raddi, *Panicum maximum* Jacquin, and *Pennisetum purpureum* Schumach.

The current pest status of *P. simulans* in sugar cane of Central America is poorly documented. Although reported as an injurious cane pest in

TABLE 1. POPULATIONS OF *PROSAPIA SIMULANS* DETECTED IN CAUCA VALLEY, COLOMBIA.

New population	Location (vereda, municipality, department)	Elev. (m)	First detection and subsequent visits: Date	First detection and subsequent visits: Estimate of population size
1	Santander de Quilichao, Santander de Quilichao, Cauca	1060	2-VI-1999	1 female
2	Santa Helena (a), El Cerrito, Valle del Cauca	1155	2-VII-1999	Unmeasured
			4-IV-2000	46.8 nymphs/m^2, 190 adults/50 sweeps
			5-V-2000	112 adults/50 sweeps
3	Cordobitas, Yotoco, Valle del Cauca	1535	1-II-2000	Unmeasured
			6-IV-2000	2.3 adults/50 sweeps
			23-V-2000	Unmeasured
4	Diamante la Gaviota, Calima el Darien, Valle del Cauca	1575	12-VI-2000	9.7 adults/50 sweeps
			27-VI-2000	13.8 adults/50 sweeps
5	La Primavera, Calima el Darien, Valle del Cauca	1621	12-VI-2000	4.0 adults/50 sweeps
			27-VI-2000	6.5 adults/50 sweeps
6	Santa Helena (b), El Cerrito, Valle del Cauca	1100	6-VII-2000	23 adults/50 sweeps
			7-X-2000	26.8 adults/50 sweeps
			26-X-2000	Unmeasured

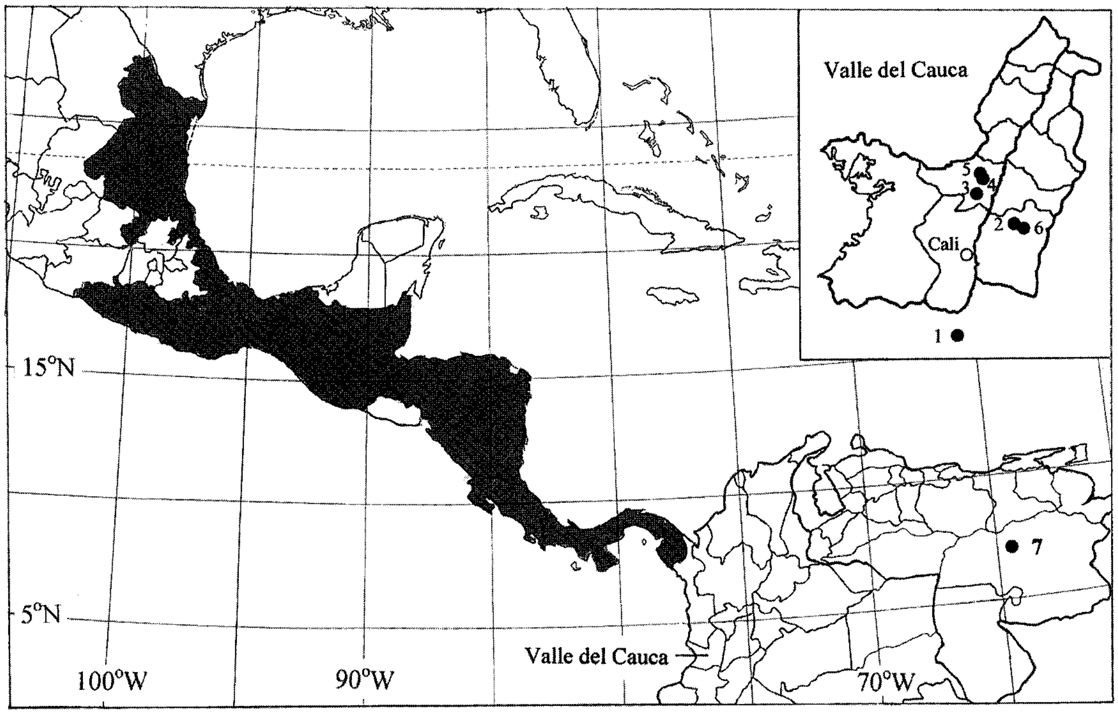

Fig. 1. Known geographic distribution of *Prosapia simulans* in Mexico (by state) and Central America (by country) with new locations (by number) in South America where it was collected in Colombia and Venezuela: 1) Santander de Quilichao 2) El Cerrito (a), 3) Yotoco, 4) Calima el Darien (Diamante la Gaviota), 5) Calima el Darien (La Primavera), 6) El Cerrito (b), and 7) La Vergareña.

Honduras and Nicaragua (J. Gaviria, consultant, pers. comm.), its pest status is probably inferior to the sympatric *Aeneolamia postica* (Walker).

Information on the specific biology and behavior of *P. simulans* is limited because most studies were conducted on a mixed species complex rather than *P. simulans* in particular. Oomen (1975) reported two generations of *P. simulans* annually in *D. decumbens* pastures near the Gulf Coast of Mexico, with preoviposition plus the egg incubation stage requiring 33.5 d, nymphal stage 25.5 d, and total generation time 58 d. Velasco & Sifuentes (1970) reported a preoviposition period of 4 d, egg incubation of 18.7 d, nymphal stage of 22-48 d and total generation time of 58.4 d. Like all other species studied in pastures, nymphs and adults of *P. simulans* occur only during the wet season, while dormant eggs survive the dry season and hatch under wet conditions. The genus *Prosapia* lays eggs in the soil but like other spittlebug species a proportion are attached to the plant stem and litter (Pass & Reed 1965, Peck 1998b). Current studies at CIAT show that *P. simulans* in Colombia primarily oviposits on the surface of the plant stem in preference to the soil or plant litter (CIAT 2000).

In all of the above studies, *P. simulans* was described as sharing pastures with another spittlebug species, such as *A. albofasciata* in northern Mexico, or *A. postica* in Honduras. There are no known published reports of it achieving outbreak status individually. The pest status of grassland cercopids in general has increased in forages of South America over the last decade. Based on reports received by CIAT (D.P., personal observation), increasingly affected areas include northern Argentina, Ecuador, and the Andean hillsides, Caribbean coast, and Amazonian forest margins of Colombia.

Diagnostic Characters

Prosapia simulans can be separated from the other 13 described species of *Prosapia* by the following male genitalic and color pattern characters (Hamilton 1977): two short blunt teeth at tip of aedeagal shaft, preapical gonopore, subgenital plates appressed on inner margins, crown of head lighter than anterior margin of pronotum, one light-colored transverse band across pronotum and two across tegmen, head and tegminal bases red to brown, and mesopleura blotched with black.

Male *P. simulans* can be distinguished from the other 17 species associated with wild and cultivated graminoids in Colombia and Ecuador (Peck 2001) by dorsal color pattern: dark brown to black with one transverse band across the center of the pronotum and two bands (complete to interrupted) across the tegmen (Fig. 2). These transverse bands are greatly reduced to absent in females. As the only known member of the genus in South America, *P. simulans* is also distinguished by the genus definition of Fennah (1949, 1953) and supporting male genitalia characters discussed by Hamilton (1977).

In Mexico and Central America, there is significant variation in the color and form of the transverse bands of *P. simulans*, ranging from yellow to pink/red to orange, broad to narrow, and distinct to completely obscured, particularly in females (Clark et al. 1976, D.P., personal observation). There is additional variation among Central American populations in color of subgenital plates and patches on ventral edge of abdominal tergites (same color as venter to black). The Colombian populations displayed a particular subset of this color and pattern variation. Of 140 males examined from across the six populations, all had narrow pale yellow tegminal bands with some reduction of the posterior band. The color of the venter was predominantly pink/red (64%), but some individuals were yellowish brown (16%) or intermediate (20%). With very few exceptions, background tegmen color was brown (versus black), subgenital plates were black, and black patches on the abdominal tergites were pronounced. Of 43 females examined, all had both tegminal bands and pronotal band greatly reduced to barely evident on a black background. Female venters were black with red (58%) to yellowish brown (30%) to intermediate (12%) markings. Background tegmen color was usually brown (74%) but sometimes black (26%).

For males (population 1, n = 40), mean (mm) ±SE (range) head capsule width, forewing length and body length (including wings) was 2.04 ± 0.009 (1.93-2.14), 6.84 ± 0.045 (5.93-7.43) and 8.52 ± 0.049 (7.36-9.29), respectively. For females (population 1, n = 40) these measures were 2.31 ± 0.009 (2.21-2.43), 6.80 ± 0.035 (6.36-7.21) and 8.71 ± 0.052 (7.29-9.29), respectively.

Mode of Introduction and Economic Considerations

Although the occurrence of *P. simulans* in Colombia and Venezuela could be attributed to low endemic populations only recently detected, we believe this is unlikely because *P. simulans* is a conspicuous insect that has warning coloration and is present in an agricultural activity vital to the region. Furthermore, the Cauca Valley and Venezuela have been under relatively high surveillance. The CIAT forages program has been active in the Cauca Valley for the last 20 years and extensive fieldwork on grassland spittlebugs was conducted in the 1950's across Venezuela (Guagliumi 1955, 1956a, b, 1957).

Alternatively, *P. simulans* may have arrived through natural or human-mediated dispersal. Natural dispersal is a possibility for the Cauca Valley populations. Given the detection of one high elevation population on the Pacific side of the western cordillera of the Andes, *P. simulans* could have spread from Panama through the Darien Gap, the Chocó region of Colombia, and down the Pacific coast. Testing this mode of introduction will depend on collections from those key intermediate regions.

Human mediated dispersal is a more likely possibility for the Venezuelan population given how remote the Venezuelan site is to Panama and the absence of *P. simulans* in northern Colombia. Spittlebug monitoring programs conducted by the Corporación Colombiana de Investigación Agropecuaria (CORPOICA), the Universidad del Sucre and CIAT over the last four years on the Caribbean coast have not detected this species. The preference of *P. simulans* for oviposition sites on the plant stem versus soil and litter increase the likelihood of entry with infested vegetative material.

Broader surveys should be carried out to identify the extent of *P. simulans* populations and monitor their spread in pastures and cane plantations of the Cauca Valley. At the spittlebug densities detected in one location of this study, milk and beef cattle production will be negatively affected and the persistence of improved *B. decumbens* pastures will be compromised. Spread or introduction of this species to lowland regions of Colombia such as the Caribbean coast or the extensive eastern Llanos would have severe economic implications.

Up to now, *P. simulans* has not been reported on Colombian sugar cane beyond the two observations noted above. Nevertheless, because the evidence suggests that *P. simulans* is a recent arrival, cane producers should consider this species a potential threat. With the notable exception of the Cauca Valley of Colombia, essentially all cane-producing regions of Central and South America have experienced major spittlebug pest problems (Fewkes 1969). For instance, the spittlebug *Aeneolamia varia saccharina* (F.) devastated the cane industry in Trinidad and other Caribbean regions at the turn of the century (Williams 1921). Brazilian cane fields have a long history with a diverse complex of other species (Guagliumi 1972) and in the last decade spittlebug pest status has increased in cane plantations of Ecuador and Central America.

The menace may be heightened now as management shifts from preharvest burning to green production by the year 2005 in the Cauca Valley (Cenicaña 1998). This change in cultural practice is known to influence the status of insect pests, such as the emergence of *Mahanarva fimbriolata* (Stal) in cane fields in São Paolo State, Brazil (P. Botelho, CCA/UFSCar, pers. comm.).

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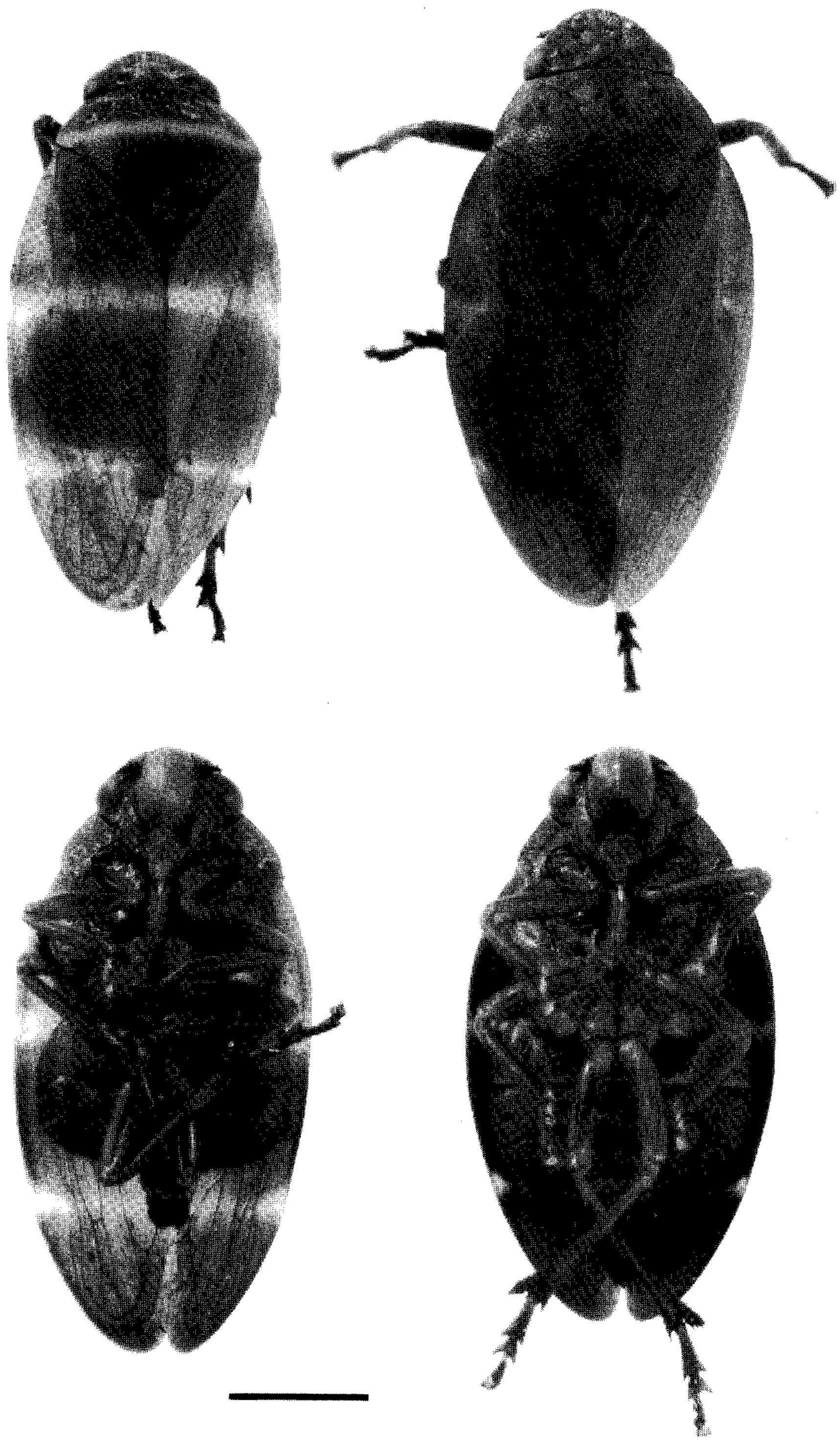

Fig. 2. *Prosapia simulans* showing most common color patterns (dorsal and ventral) of males (left) and females from newly detected populations in Cauca Valley, Colombia. Bar = 2 mm.

Finally, these observations highlight the need for care in transfer of vegetative and soil materials associated with cercopid host plants. There is some other anecdotal evidence for regional introductions of grassland spittlebugs such as *Z. carbonaria* from the Cauca Valley into the Colombian Amazon, and an isolated report of the Central Brazil species *Notozulia entreriana* (Berg) in the Colombian Llanos (Peck 2001). One well-documented case is *Lepyronia coleoptrata* (L.) (Homoptera: Aphrophoridae), a Palearctic spittlebug with immigrant status in the United States (Hoebeke & Hamilton 1983). With the increasing movement of vegetative material throughout the Caribbean Basin and northward insect range expansion due to warming trends, sugar cane and forage grass production in the southern United States, like the Cauca Valley, would be threatened by the arrival of new spittlebug pests. The southeast United States already suffers from the native *Prosapia bicincta* (Say), a damaging pest of forage grass, turf grass and ornamentals (Fagan & Kuitert 1969; Braman & pendley 1993; Braman & Ruter 1997).

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