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Studies on Crambidae IX—On the identity of *Botis bicolor* Swainson, [1821], its generic placement, some related species, and a new species from South Africa (Pyraloidea, Crambidae, Spilomelinae).

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Abstract: The identity of *Botis bicolor* Swainson, [1821] is established, and topotypes are designated. Externally similar species from Africa are studied: the identity of *Diaphania perspicillalis* (Zeller,1852), **bona spec**, **stat. rev.**, **comb. nov.**, and of *Diaphania desmialis* (Mabille,1900) **comb. nov.** is discussed; and a new species *Diaphania unipunctalis* **sp. nov.** is described from South Africa. The synonymy of all species is discussed as is their distribution, and some remarks on the generic placement are given. Illustrations are given for the adult moths, genitalia and tympanal organs.

Key words: *Diaphania bicolor* (Swainson, [1821]) (*Botis*); *Diaphania desmialis* (Mabille,1900) **comb. nov.**; *Diaphania perspicillalis* (Zeller,1852), **bona spec**, **stat. rev.**, **comb. nov.**; *Diaphania unipunctalis* **sp. nov.**; identification.
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INTRODUCTION

The species *bicolor* was originally described and illustrated (Fig. 1) by Swainson (1821) and published in the genus *Botis* Swainson,1821. As type locality, the author gives "America". This locality is considered doubtful and could not be confirmed, therefore "America" may be an error by the author. Over the years the true locality is assumed to be Ceylon or India. In fact, the species as illustrated by Swainson (Fig. 1) is found as *bicolor* in older collections from that area. There is no species known with this wing pattern from the Americas. The species identified as *bicolor* Swainson is at present placed in the genus *Glyphodes* (see: LepIndex, 2003-2025; Afromoths, 2025; https://www.pyraloidea.org/, 2025). Three species names are listed as synonyms for this species: *Glyphodes diurnalis* Guenée, 1854 from India (Coromandel); *Glyphodes parvalis* Walker, [1866] 1865 also from India (S. Hindoestan); and *Eudioptis perspicillalis* Zeller, 1852 from South Africa (Limpopo and Gariep). In this study and for the species considered here, the male and female genitalia are found not to be congeneric with the type species of the genus *Glyphodes* Guenée, 1854 (*Glyphodes stolalis* Guenée, 1854) but are congeneric with the type species of *Diaphania*, Hübner, 1818 (*Phalaena (Pyralis) nitidalis* Stoll, 1781). It has the similar long slender uncus and bell-shaped tegumen. Therefore, the species is a **comb. nov.** in *Diaphania*.

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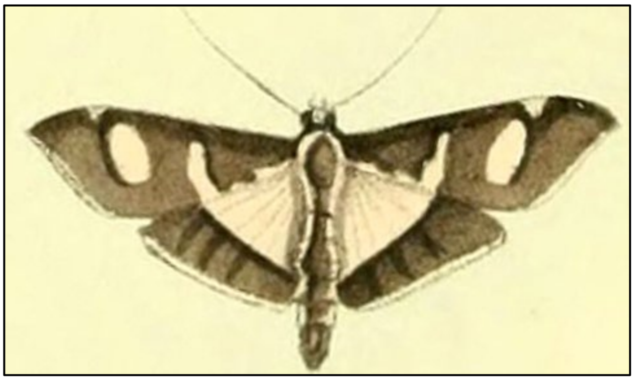

Figure 1 – *Botis bicolor* Swainson, 1821 Original image.

The type species of *bicolor* could not be found and is considered lost. For this study, material was examined of what is assumed the type locality or type region. Based on the original image and material from different collections and localities, the identity of *bicolor* is re-established. Some species externally similar to *B. bicolor* are studied. Identities of published names and their status are examined. For the mainland of Africa, the name *Eudioptis perspicillalis* Zeller is removed from the synonymy of *B. bicolor* and considered as a valid species. The type of *Glyphodes bicoloralis* Strand, 1912 was examined and is found to be a new junior subjective synonym of *G. perspicillalis*. Material from Madagascar was also studied and one name, *Glyphodes desmialis* Mabille,1900, fits the description of the "*bicolor*" wing pattern. From the description by Mabille, it cannot be determined if this is a synonym of *G. perspicillalis* or a separate species. The type of *desmialis* could not be located (Viette & Fletcher, 1968), and no material was found in collections with this identification label. This species name is also not mentioned by Viette (1990) in his provisional checklist of the Lepidoptera Heterocera of Madagascar or by Krüger (2020) in his checklist of the Lepidoptera Heterocera of

Southern Africa. The genitalia of the Madagascar specimen studied are different from those of *D. perspicillalis*. No *D. perspicillalis* specimens could be found in the collections studied and therefore the re-description of *desmialis* Mabille, 1900 is preferred over the creation of a new species while this name would otherwise remain a question mark or remain lost (as mentioned above). The adult moth and the male genitalia are illustrated but the female genitalia are currently not known. In addition, while studying African material with the "*bicolor*" wing pattern, a new species from South Africa was discovered and is described below.

On the generic level, the situation is more complicated and cannot be resolved here. The name *Botis* was created by Swainson but is a misspelling of *Botys* Latreille [1802 Nov. 6] which is a synonym of *Pyrausta* Schrank 1802 [Apr. 24]. This name was considered as a valid genus by Speidel, 1989 and is the type genus of the subfamily Pyraustinae. The species *Botis bicolor* Swainson, [1821] is currently placed in *Glyphodes* (see references above) but is here placed in the genus *Diaphania* based of the structure of the uncus, the tegumen, and the valva in the male genitalia. The species *Diaphania bicolor* (Swainson, [1821]) **comb. nov.** is closely related to *D. perspicillalis* (Zeller) **comb. nov.**, to *D. desmialis* (Mabille) **comb. nov.** and to *D. unipunctalis* **sp. nov.**, because of similarities not only externally, but also in the uncus in the male genitalia and, in the former two species, the corpus bursae with signum in the female genitalia. Furthermore, the generic placement remains difficult until a full revision of the above genera and species is undertaken. From the current dissections, I can only conclude that *D. bicolor* is close to *Glyphodes actoronialis* Walker, 1859 and some related species: *Glyphodes conclusalis* Walker, [1866] 1865; *Glyphodes ernalis* Swinhoe, 1894; *Glyphodes minimalis* Hampson, 1896; *Glyphodes tumidalis* Warren, 1896; and *Glyphodes violalis* Warren,1896 (all from the Oriental Region) to name a few. From current dissections, I must conclude that *Glyphodes* is polyphyletic and over the years it has been used by different authors as a "dustbin" genus. The wing pattern allows the grouping of species. In addition, there are significant differences in the male genitalia and groupings can be made based on the structure of the uncus, tegumen in the male genitalia, and the overall structure of the female genitalia. Overall, it is necessary to make a global study including most species to evaluate the value of structures. At present the studies only include species from South East Asia and Australia. (Sutrisno, 2002; Sutrisno, 2003; Sutrisno et al., 2008). For the African continent the situation remains unclear, and different lineages seem to be present, with confusion on the identity of species and several undescribed species.

Methods and materials

Genitalia were dissected following Maes (1985) (modified from Robinson, 1976) except that now the abdomen is opened laterally to better show the characters on sternites and tergites. The types were studied in the NHMUK (London), Museum für Naturkunde (MFN), Berlin, and additional material was studied from ABSRC, and RMCA and RMNH.

Abbreviations used

ABSRC: AgroBioSys Intl. Reference Collection, Wetteren, Belgium
MFN: Museum für Naturkunde, Berlin, Germany.
NHMUK: The Natural History Museum, London, UK.
RMCA: The Royal Museum for Central Africa, Tervuren, Belgium.
RMNH: Rijksmuseum Natuurlijke Historie, Leiden, The Netherlands.

Results

Crambidae Latreille, 1810
Spilomelinae Guenée, 1854
Margaroniini Swinhoe & Cotes, 1889

Diaphania bicolor Swainson,1831 **comb. nov.** Figs. 2–7.
Swainson, [1821] Zoological illustrations, or by William Swainson (*Botis*)
Glyphodes diurnalis Guenée, 1854 in Boisduval & Guenée, Hist. nat. Insectes (Spéc. Gén. Lépid.) 8:294, pl.5, Fig. 5 (*Glyphodes*)
Glyphodes parvalis Walker, [1866] 1865 List Specimens lepid. Insects Colln Br. Mus. 34:1355 (*Glyphodes*)

Figure 2 – *Diaphania bicolor* (Swainson, 1821) ABSRC3578 topotype.

Type material examined: *Botis bicolor* Swainson,1831: type not found, presumably lost. The illustration on the original publication is used.
Glyphodes diurnalis Guenée, 1854 Coromandel (abdomen missing) (NHMUK).
Glyphodes parvalis Walker, [1866] 1865 S. Hindoestan (abdomen dislodged, glued on plastazote strip) (NHMUK).
Additional material examined: ♂: (Topotype) Ceylon Haputale November/ K.Maes Gen.Prep.nr.♂2458/ ABSRC1003679. ♀: (Topotype) Ceylon Maskeliya August/ K.Maes Gen.Prep.nr.♀2457/ ABSRC1003678. ♂: China, Hong Kong, Kadoorie Agr. Res. St., Shek Kong, Yuen Long, N. Territories. 22°N 114°E, 600m, Mercury Vapor Light; 05.viii.1998; R.C.Kendrick/ K.Maes Gen.Prep.nr.♂2461/ ABSRC1003680. ♂: Laos, Luang Prabang, Vieng Him Soung. 20°42'48.51"N, 102°32'57.73"E, 954m, MV Light; 30.iv.2019 to 01.v.2019; K.Maes/ K.Maes Gen.Prep.nr.♂2676/ ABSRC1002866. ♂: Vietnam, Nghe An Prov., Khe Lanh (limestone forest) Pu Huong Nature reserve. 19°20'9.4914"N, 105°11'1.7514"E, 79m, MV Light; 20-VII-2024; Phan Toán Quốc/ K.Maes Gen.Prep.nr.♂2559/

ABSRC1004907. ♂: Vietnam (Haiphong) Cat Ba island National Park N. forest on slopes near headquarters, 100m UTM: 48Q YJ075007 (GPS); 05.x.2003; C.vd Berg & EJ v Nieukerken RMNH/EvN no:2003166/ K.Maes Gen.Prep.nr.♂RMNH.INS.1675137/ RMNH.INS.1675137.

Diagnosis: (Fig. 2) ground color black and white: forewing with a white band originating from the inner margin of the forewing but not reaching the costa; postmedial oval white spot. Hindwings white with a broad, black subterminal band, postmedian line straight. Vesica in aedeagus with multiple spines packed as a dense bunch; female genitalia with a broad antrum, well sclerotized; ductus bursae wide; corpus bursae with a simple transversal signum.

Figure 3 – *Diaphania bicolor* (Swainson, 1821) ABSRC1004095 lateral view head.

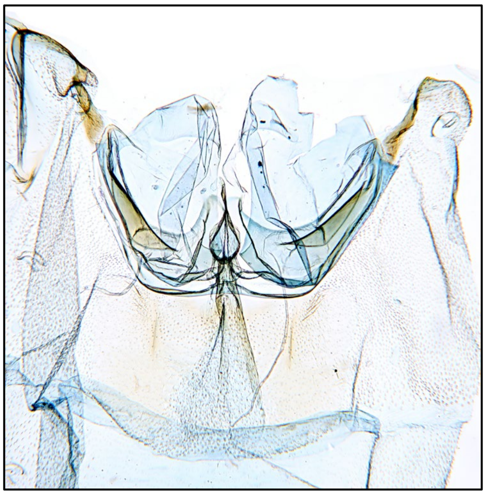

Figure 4 – *Diaphania bicolor* (Swainson, 1821) GPKM♂2676 tympanal organs.

Description:

Head: (Fig. 3) frons rounded, maxillary palps close to base labial palps, upturned, first segment white at base, second segment black, terminal segment white; labial palps upturned, ventrally white with a black streak at the base of the first segment, second segment black, third segment small, white; antenna filiform.

Thorax: forewings triangular black with some white spots: oval white spot just beneath costa towards the inner margin, oval white spot just before the subterminal area, a small triangular spot beyond this oval spot on the costa; hind wing with white base and a black postmedial field delimited by a coal black lining on the inner side; smal black area on the white anal area.

Abdomen: dorsally black, pleural area white, ventrally dark grey with black lining around the margins of the tergites.

Tympanal organs: (Fig. 4) praecinctorium well developed, bilobed; fornix tympani broad, widening near the pons tympani; processus tympani very large; saccus tympani shallow; venula secundae very faintly sclerotized, visible on the slightly sclortized sternum; bullae tympani bean-shaped.

Figure 5 – *Diaphania bicolor* (Swainson, 1821) GPKM♂2461.

Figure 6 – *Diaphania bicolor* (Swainson, 1821) GPKM♂2461 aedeagus.

Male genitalia: (Figs. 5, 6) Typical *Diaphania*-type genitalia: long needle-shaped, distal somewhat dilated, ventrally with some setae; tegumen as a U- or bell-shaped structure with a well developed saccus. Valva rounded, rather short, membranous, sacculus with a simple fibula which is terminlly forked. Aedeagus tubular, one part sclerotized, vesica with a simple cornutus consisting of multible simple spines and a bunch of long (1/3 of length of aedeagus) needle-shaped cornuti.

Figure 7 – *Diaphania bicolor* (Swainson, 1821) GPKM♀2457.

Female genitalia: (Fig. 7) Papillae anales with short and long setae; apophyses posteriores, thin, of about half the length as apophyses anteriores; ostium narrow, membranous; antrum as a sclerotized ring; ductus bursae half width of corpus bursae; the latter long ovoid with a simple, narrow signum composed of multiple small sclerotizations.

Remarks: with this description and illustrations of adult, male and female genitalia, the identity of this species is re-established here. The types of the two synonyms were examined and their synonomy is confirmed based on the external characters since *diurnalis* has the abdomen missing and *parvalis* has a dislodged abdomen. But both are from the (assumed) area of distribution of *B. bicolor*. There are several other species in the Oriental region with this typical black and white wing pattern but their correct identity falls beyond the scope of this paper.

Diaphania perspicillalis (Zeller, 1852) **bona spec**, **stat. rev.**, **comb. nov.** Figs. 8–12.

Lepidoptera Microptera p.53 (*Eudioptis*)

Glyphodes bicoloralis Strand, 1912 Arch. Naturgesch. 78, A2:70 (*Glyphodes*) **syn. nov.**

Type material examined: *Eudioptis perspicillalis* Zeller, 1852: type not found, may be lost.
Glyphodes bicoloralis Strand, 1912: [Cameroon] Johan Albrechtshöhe (abdomen damaged, genitalia lost) (MFN)
Additional material examined: ♀: South Africa, Limpopo, Hoedspruit Casketts farm, 24°20'35.8"S, 31°09'7.2"E; 02.vi.2014; A. & I. SHARP (emerged) (bred on Secamone sp. (Apocyanaceae))/ K.Maes Gen.Prep.nr.♀2653/ ABSRC1004135. ♂: Cameroon, Center, Mt. Fébé, 1070m; viii.1993/ ABSRC1003652. ♂: Cameroon, Center, Mt. Fébé, 1070m viii.1993/ ABSRC1003651. ♂: Cameroon, Center, Mt. Fébé, 1070m; vi.1993/ ABSRC1003653. ♀: Cameroon, Northern, Hippo Camp, near Faro N.P. 08°23'36.4"N, 12°49'26.03"E, 297m; F-15TB/BL influorescent and 160W MML lights; 13-15.vi.2023; K.Maes/ K.Maes Gen.Prep.nr.♀2459/ ABSRC1003211. ♂: Cameroon, Dschang 10.3.'88 K.Maes/ K.Maes Gen.Prep.nr.♂814/ ABSRC1003650. ♂: Tanzania, Morogoro, 7.1 km S. of Mikumi, 7°27'22.8"S 37°00'25.6"E, 500m; Black/MV lights; 10.vi.2001; K.Maes/ ABSRC1003654. ♂: Tanzania, Morogoro, 7.1 km S. of Mikumi, 7°27'22.8"S, 37°00'25.6"E, 500m; Black/MV lights; 06.vi.2001; K.Maes; ABSRC1003655. ♂: Namibia, Mile 46 18°18'S, 19°15'E; 24-28.iii.2003; leg. W. Mey/ ABSRC1003659. ♂: [D.R.C.] Elisabethville, 29.x.1933; Ch.Seydel/ RMCA ENT 000007818. ♀: [D.R.C.] Musée du Congo Kil. 345 de Kindu, nuit. Dr. Russo/ RMCA-ENT-000045172. ♀: Côte d'Ivoire, Bouaké, INUPA; 25-26.vi.1983; lumière Col. Stamm V 12.5.51/ K.Maes Gen.Prep.nr.♀14418/ RMCA-ENT-000045171. ♂: Chad, Bebedjia, 8°40'N, 16°33'E, 395m; 25.vi.1971; F.A.Bink/ K.Maes Gen.Prep.nr.♂RMNH.INS.1675132/ RMNH.INS.1675132. ♂: Chad, Bebedjia, 8°40'N, 16°33'E, 395m; 11.xi.1971; F.A.Bink/ RMNH.INS.1675133; ♂ : Zaire [D.R.C.] Region de Kinshasa, Bombo, Lumene; 22.i.1993; Coll.Ph.Oremans/ RMNH.INS.1675134. ♀: Gabon, Woleu-Ntem, Monte de Cristal, Tchimbele, 0°37.3'N 10°24.2'E, 580m; 17.ix.1994; J.J.Wieringa/ RMNH.INS.1675135. ♀: Cameroon, Zuid, Angalé 14.vii.1974; J.A.W.Lucos/ RMNH.INS.1675136.

Diagnosis: (Fig. 8) forewings with two large white spots: one in the median area, one larger near the postmedian line. A small white triangular spot near the costa and the postmedial fascia. Male genitalia with a spatula-shaped fibula, aedeagus with a spine-shaped cornutus bearing on one side short spines; female genitalia with a well sclerotized tubular antrum.

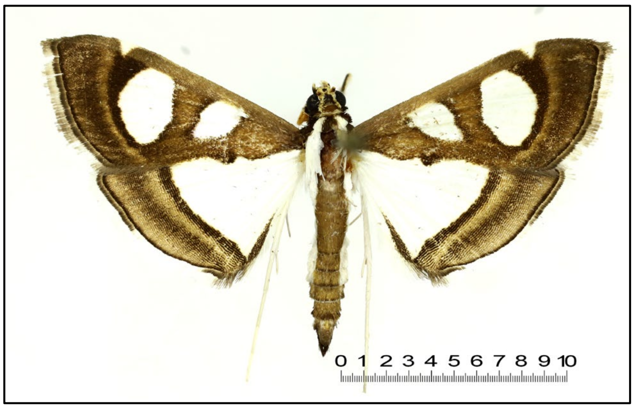

Figure 8 – *Diaphania perspicillalis* (Zeller, 1852) ABSRC1003659.

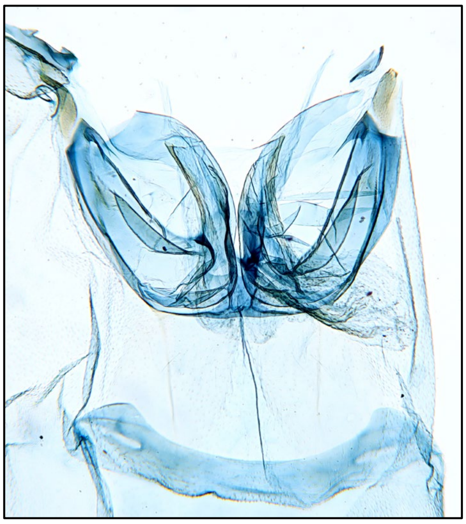

Figure 9 – *Diaphania perspicillalis* (Zeller, 1852) GPKM♀2653 tympanal organs.

Figure 10 – *Diaphania perspicillalis* (Zeller, 1852) GPKM♂814.

Description:
Head: as previous species.
Thorax: basically as *D. bicolor* but the oval white spot below the costa more oval and the spot is not reaching the inner margin of the fore wing; white subterminal spot larger as in *D. bicolor*; triangular white spot near costa present. hind wing with white base and a black postmedial field delimited by a coal black lining on the inner side, a diffuse lighter band may be present along the inner margin, inner band of the postmedial field black but slightly curved not straight as in *D. bicolor*; small black area on the white anal area.
Tympanal organs: (Fig. 9) as previous species.
Male genitalia: (Fig. 10, 11) uncus needle shaped with sparse simple setae along its length and terminally some elongated setae; tegumen as *D. bicolor* valva somewhat longer, rounded with a simple spatula-shaped fibula. Aedeagus only terminally stronger sclerotized, with a simple serrated ridge as cornutus.

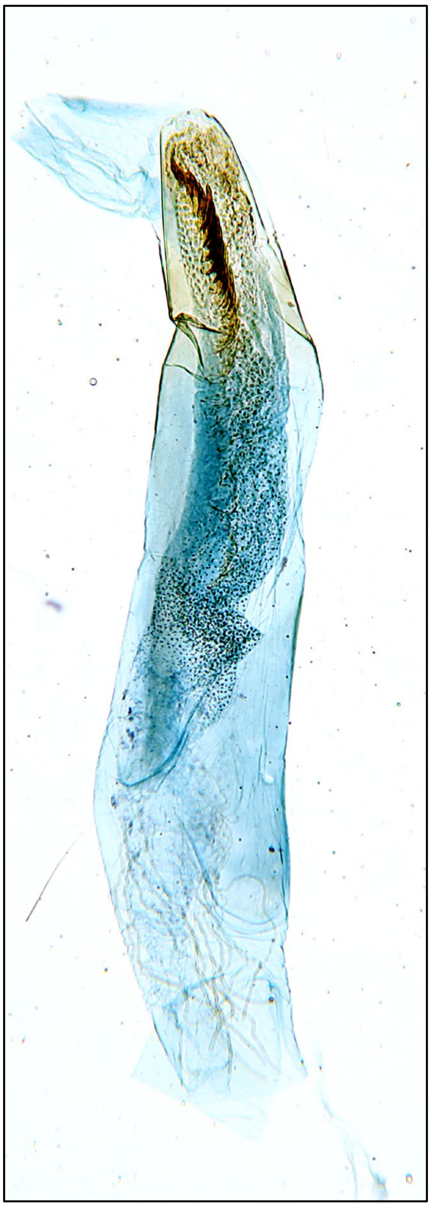

Figure 11 – *Diaphania perspicillalis* (Zeller, 1852) GPKM♂814 aedeagus.

Female genitalia: (Fig. 12) papillae anales with long and short setae, membranous; apophyses posteriores about half the length of the apophyses anteriores; sinus vaginalis membranous, antrum tubular strongly sclerotized; ductus bursae about half the width of the corpus bursae, membranous; corpus bursae with a linear, medially widened linear signum.

Figure 12 – *Diaphania perspicillalis* (Zeller, 1852) GPKM♀2489.

Distribution: Africa, specimens studied from Côte d'Ivoire, Cameroon, Chad, Gabon, D.R.C., Tanzania, Namibia, Republic of South Africa.
Foodplant: *Secamone* sp. (Staude *et al.*, 2016) (Apocyanaceae).
Remarks: In contrast with the *D. bicolor* group in S.E.Asia, where there are several similar looking species, there seems to be much less speciation with this particular wing pattern (black and white wing pattern) in *Glyphodes* or *Diaphania* species in Africa and its islands. The Asian species are not discussed here since a prelimanry study shows a more complicated taxonomic situation with some mimicry. *Diaphania perspicillalis* has a wide distribution and occurs from West Africa over Central to South Africa. There is some variation in the size of the white dots on the forewing but this is not reflected in the genitalia which are identical in all the studied specimens.

Diaphania desmialis Mabille, 1900 **comb. nov.** (Figs. 13–16)
Annls Soc.ent.Fr. 68(1899):746 (*Glyphodes*)

Type material: type lost (Viette & Fletcher, 1968)
Additional material examined: ♂: C-Madagascar Forêt d'Ankozomivady Ambalamanaikana, 1600m; 3-12.xii.2007; Fr. & A Aulombard/ K.Maes Gen.Prep.nr.♂2460/ ABSRC1003681.
Diagnosis: (Fig. 13) externally largely as *D. perpsicillalis* but with a smaller white spot in the cell of the fore wing, a comma-shaped white line near the apical tip of the fore wing and a larger black band on the outer edge of the hind wing. Male genitalia similar as *D. perspicillalis* but the aedeagus lacks the spine-shaped cornutus.

Figure 13 – *Diaphania desmialis* (Mabille, 1900) GPKM♂2460.

Figure 14 – *Diaphania desmialis* (Mabille, 1900) GPKM♂2460 tympanal organs.

Description:
Head: as previous species.
Thorax: fore wings triangular, dark grey to black with some white spots, each spot delimited by a thin black line: small oval white spot in the cell; larger oval white spot just before the subterminal area, a small white linear spot beyond this oval spot on the costa touching the the dorsal edge of the larger oval subterminal spot; fringe dark grey to black from the apex towards CuA1 then white towards the lower edge of the fore wing; inner margin of the fore wing white for up to three parts of its length with a small triangular white spot near the middle of the fore wing; hind wing with white base and a large blackish postmedial field, inner margin delimited by a thin black line, curved; anal area white with some black scaling near the outer part; fringe black.

Figure 15 – *Diaphania desmialis* (Mabille, 1900) GPKM♂2460.

Tympanal organs: (Fig. 14) as previous species.
Male genitalia: (Figs. 15, 16) uncus long, needle-shaped terminal dilated with some longer setae, slightly longer as in *D. perspicillalis*; valva as the former species but spatula-shaped fibula somewhat longer; aedeagus tubular, vesica with some very small scleritizations, no cornutus present.
Female genitalia: unknown.
Distribution: Madagascar.
Foodplant: unknown.
Remarks: The original description by Mabille covers perfectly *D. perspicillalis* Zeller but no *perspicillalis* specimen could be found that was collected from Madagascar. Instead, the above specimen that also fits that description was studied, and it was found different in the genitalia from *perspicillalis*. It is also surprising that in the checklist by Viette (1990) and Krüger (2020) the name of *desmialis* Mabille is not mentioned, neither for Madagascar nor for Southern Africa. This may be due to the fact that Mabille did not explicitly mention Madagascar nor [South] Africa as a type locality and the name was forgotten. On the other hand, the name was mentioned by Viette & Fletcher (1968) when the type species of Mabille were studied. Since Mabille's species were mostly from Madagascar, I prefer to use this name as a valid species, instead of placing it as a junior objective synonym of *B. perspcillalis* Zeller and describe this specimen as a new species.

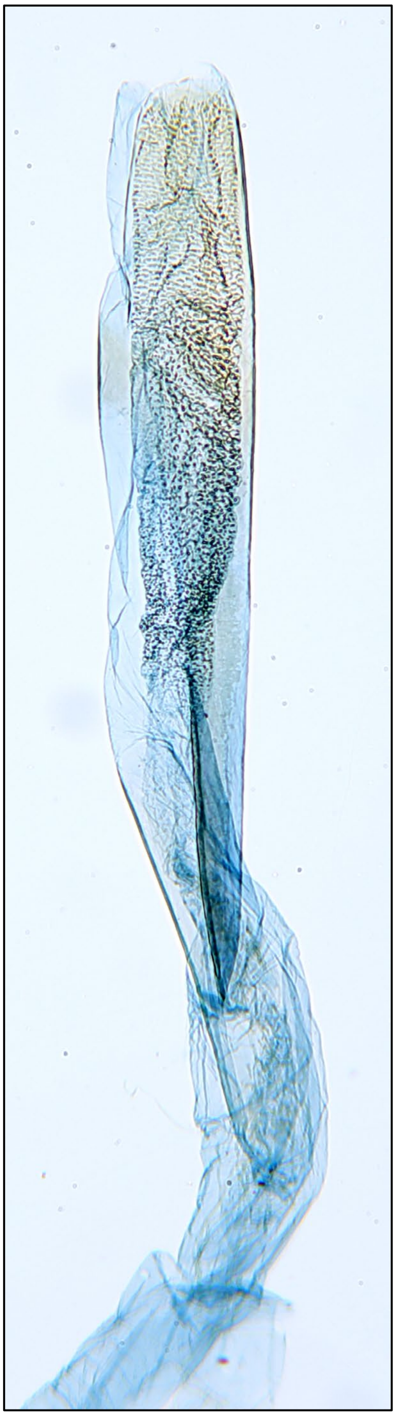

Figure 16 – *Diaphania desmialis* (Mabille, 1900) GPKM♂2460 aedeagus.

Diaphania unipunctalis **sp. nov.**
Figs. 17–19.
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Type material: Holotype ♂: [South Africa] Transvaal Johannesburg 1895 Coll. Schuit/ K.Maes Gen.Prep.nr.♂RMNH.INS.1675131/ RMNH.INS.1675131 (RMNH).
Diagnosis: (Fig. 17) forewing triangular, first white spot in the cellular area white, very small, second white spot, large, rounded; small white spot near the apical end more linear as trianglular; male genitalia with a very large narrow uncus, terminally with elongated setae; valva rounded, rather short with a needle shaped fibula; aedeagus tubular, cornutus lacking.

Figure 17 – *Diaphania unipunctalis* Holotype RMNH.INS.1675131.

Description:
Head: as previous species.
Thorax: forewings triangular black with some white spots: smaller white spot in the cell; larger oval white spot just before the subterminal area, a small white linear spot beyond this oval spot on the costa; hind wing with white base and a uniform black postmedial field, inner margin of this postmedial field slightly curved; anal area white, no black scaling.
Tympanal organs: as previous species.
Male genitalia: (Figs. 18, 19) uncus quite long, slender, needle-shaped, terminally somewhat widened with some elongated scales; tegumen as previous species; valva rather short, rounded with a median spine-shaped fibula; aedeagus tubular, vesica membranous without cornuti.
Female genitalia: unknown.
Distribution: Republic of South Africa.
Foodplant: unknown.

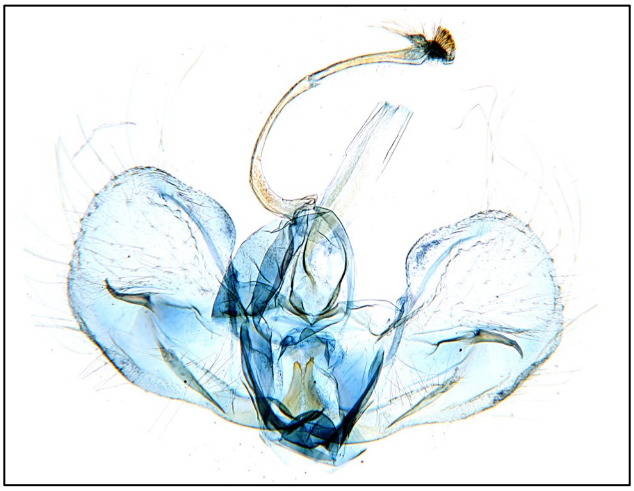

Figure 18 – *Diaphania unipunctalis* Holotype RMNH.INS.1675131 male genitalia.

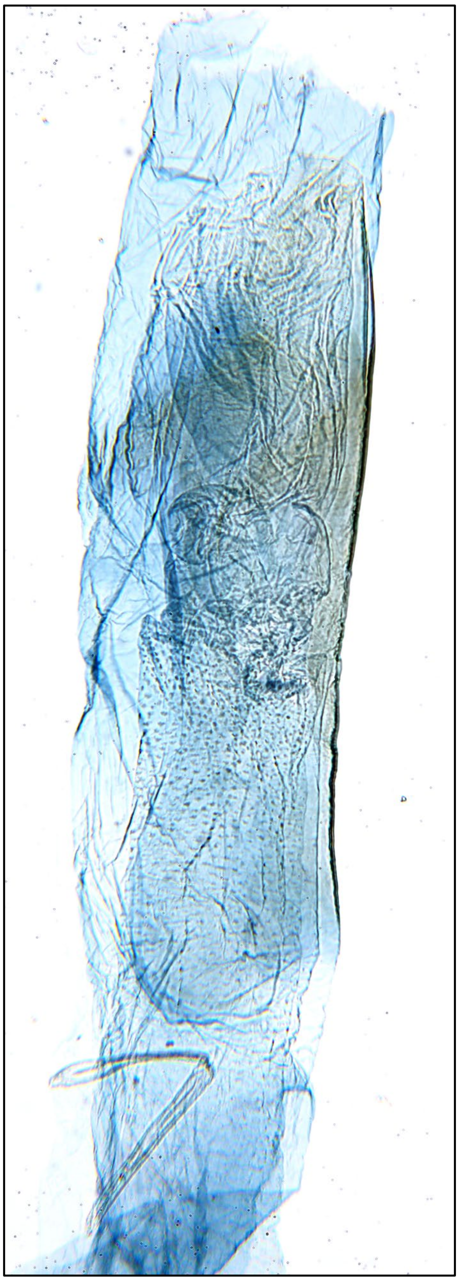

Figure 19 – *Diaphania unipunctalis* Holotype RMNH.INS.1675131 aedeagus.

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