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SCROBIPALPOPSIS SOLANIVORA SP. N. — A NEW PEST OF POTATO (Solanum tuberosum) FROM CENTRAL AMERICA

Scrobipalpopsis solanivora sp. n. — nový škůdce brambor ze střední Ameriky

Scrobipalpopsis solanivora sp. n. — новый вредитель картофеля из Средней Америки

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Abstract

Povolný, D.: *Scrobipalpopsis solanivora* sp. n. — a new pest of potato from Central America. *Acta univ. agric. (Brno), fac. agron.*, XXI, 1973, 133—145.

The author describes a new species of the genus *Scrobipalpopsis* Povolný, 1967 from Costa Rica (Central America). The species was sent for identification being originally considered a moth of the genus *Scrobipalpa* Janse. The study of the material of larvae and moths revealed a new species described as *Scrobipalpopsis solanivora* sp. n. Both moths and larvae are striking due to their size, wing pattern and colouration, but the species is also characteristic by several imaginal and larval criteria. The new species is the greatest known form of the genus *Scrobipalpopsis* showing certain relations to *Scrobipalpopsis petasitis* (known to occur both in North America and Europe) and *S. tetradymiella* (California, U.S.A.), but being specifically quite different. The species is believed to have been introduced to Costa Rica, in the year 1970, with a shipment of seed potatos. It expanded throughout the region of potato cultivation in Costa Rica, mainly in elevations between 1,300—2,300 m. In the year 1972, it caused the loss of about 20%—40% of potato crop in an area of 2,000 hectars, corresponding the value of about 900,000 $ (U.S.). The larvae attack tubers, which they may completely destroy. Occasionally, also green parts of plants may be injured. Also, stored potato tubers may be heavily injured. The total development (egg — imago) lasts about 6 weeks. To the opinion of specialists, this pest seems to be more injurious to potato than the famous potato-tuber moth [*Phthorimaea operculella* (Zell.)]. It is, therefore, proposed to put the name of this new insect pest on the International List of Quarantine Pests of potato.

Key words: potato-tuber moth; pest of potato; Central America; ecology of pests of potato.

By courtesy of Prof. Gilbert Fuentes(Head, Department of Entomology, University of Costa Rica, San José, Costa Rica) a series of moths and caterpillars responsible for the considerable damage caused to cultured potato, (Solanum tuberosum), in Costa Rica, were forwarded to my address. As indicated by Prof. Fuentes, the moths had been reared from caterpillars collected in Llano Grande (Province Cartago) on 24th October, and on 10th January, 1973. The material was examined in this institute. The results revealed an undescribed species classed with the little known genus *Srobipalpopsis* Povolný, 1967. This discovery is a contribution to both theoretical and practical knowledge of the tribe *Gnorimoschemini* in Central America. The species is described in the following part.

Scrobipalpopsis solanivora sp. n.

Described on the basis of 39 spread and well preserved moths and of 7 adult late instar larvae fixed in Dietrich's solution.

Habitus of imago

For the tribe *Gnorimoschemini*, a comparatively large broadwinged and stout moth. General colouration deep to light brown with a rather poorly defined radiate forewing pattern in the male but very pronounced in the female.

Head, thorax and tegulae deep brown (♂) to light brown (♀). Especially in light brownish females a dark narrow strip is visible stretching from the off-standing scales of the head vertex to middle of the thorax. In the heavy labial palpus the second segment is covered by erect scales, while the third, not very slender, is covered by normal appressed scales. Colouration of the palpus, which is darker in males than in females, is also brown, but individual scales have distinctly brown to browngrey tips, in most cases. Outward surface of the second segment with one basal and one subterminal, not strictly limited, dark spot, which may fuse in males. Inward surface of the second joint is pale. The third labial joint distinctly deep brown to dark grey with a medial ring or spot of light scales, indistinct in males.

Forewings comparatively broad. Ground colour chocolate brown (males) or bright brown (females) and with a trinity of well visible stigmata with a bright and, especially in females, a distinctive pattern of longitudinal lines, these are distinct in the tornus terminating in the form of more or less developed marginal spots. Costal margin distinctly darker brown, especially in males, similarly as the striking axial stripe or shade stretching and widening from the third stigma to the wing tip, where it ends in the form of a dark ocellus. An admixture of deep brown to dark grey scales is found centrally before and between the trinity of stigmata. In males, a narrow area of lighter scales is found subcostally, as well as above and between the second and third stigmata, with a tendency to form longitudinal lines towards the wing tornus. Blackish stigmata are surrounded by light brown scales, but the first stigma tends towards reduction being sometimes represented only by a trace of ochreous scales. In females, the whole wing, with exception of a darker costal margin and an axial longitudinal shade, has a rich pattern of pale longitudinal lines following the blackish venation, and the area around the stigmata is also pale. Pale ochreous hair-like scales of the forewing margin are separated by a dark line from the pattern, which ends in the form of marginal spots. In males, hindwings dark grey, sparsely suffused with blackish scales along the costal margin, and veins. In females, the hindwing is light grey with similar blackish suffusion. Marginal hairs blackish to grey, in both sexes. Abdomen dorsally graphite grey, ventrally whitish dusted with two parallel longitudinal lines of brown colour. Legs brown to whitish sprinkled, outward side brown to grey, inward side pale. Tibiae of the third pair with long and dense dorsal hairs. Forewing 7.2 (♂) to 10.6 (♀) mm.

Sexual dimorphism is apparent in both size and colouration. Males are deep brown with two (second and third) stigmata as a rule, but mostly without strong longitudinal markings. Females are visibly larger in most cases, brighter brown in colour, with a more distinctive pattern of three stigmata and longitudinal linear markings.

Genitalia

♂ — Stout and heavy, in general appearance similar to those of the genus *Scrobipalpa* Janse and with all the elements characteristic of this genus (see Povolný, 1967), but differing in size, chitinization, and in several minute characters.

Uncus narrowed with a distinct obtuse tip. Gnathos thorn-like and well developed. Valvae stout, with moderately curved cyllindrical bases and shovel-formed flat tips. Parabasal processes of valvae well defined and distinctly curved inwardly. Saccular wall broad (tall) provided with a pair of symmetric processes; these are rather flat, falciform and separated by a symmetric medial excision. Their tips do not reach over those of the parabasal processes. Saccus comparatively broad and long, but not longer than the lateral teguminal corners. Aedeagus long and strong, only a little shorter than the distance between tips of the saccus and uncus. Basal part of aedeagus only slightly inflated, subterminal hooklet of aedeagus prominent. The variability is unimportant, for it concerns mostly the size corresponding with that of the males. Form of saccus and the paired processes seem to be slightly variable (fig. 13, 16).

♀ – Subgenital plate subquadrate, smooth, apophyses long. Above the place where the 8th sternite emits the anterior apophyses the edges are membranous and concave. Inner edge of apophyses provided with a characteristic tubercle. Central part of the subgenital plate transparent membranous, without any sculpture. Proximal part of 8th sternite before ostium bursae chitinised in the form of a paired crescent separated medially by a triangulate membrane. Ostial ringlet broad chitinised and proximal portion of ductus bursae sclerotised. Signum is a strongly arched thorn-like hooklet.

The subgenital plate is quite characteristic of the genus, lacking in foamy sculpture of the genus *Scrobipalpa* Janse and having the characteristic tubercle and dilatation on inner edges of the anterior apophyses.

Larva

Habitus

Description based on fully or nearly fully grown larvae (probably of 5th instar) 12.4–14.2 mm long. Head, shield (pronotum) and tubercles pale chitine brown. Sutures of head and mandibles chestnut brown or dark brown. Thoracic legs pale. Body colouration bright red-scarlet with pale to whitish pleurae and body underside. Red colouration more expressive than in other known gnorimoschemoid larvae (e. g., in some species of *Scrobipalpa*), where it is usually pink, and does not form longitudinal stripes. In dorsal view, the scarlet colour covers the individual segments being nearly absent from the intersegmental cuticle, which is pale. On each segment, the scarlet is interrupted and forms fine irregular narrow lines. The red colouration does not substantially vary, as for its intensity. Laterally, the red colour grades into pink and subventrally into pale pink or whitish, similarly as the body underside. Central proleg crochets 19–22 and nearly in uniordinal circle, anal crochets 11 to 12, uniordinal serial. The tarsi are spinulate.

Morphology and chaetotaxy

Head rather large, well rounded. Adfrontal setae Frl_2 ($adfr_1$) and Frl_1 ($adfr_2$) only slightly nearer each other than Frl_1 ($adfr_2$) to clypeal seta (Cl_1). Frontal seta F_1 of nearly same length as clypeal seta Cl_2, this being visibly longer than Cl_1. These relations are more similar to *Scrobipalpa*, *Gnorimoschema* and *Symmetrischema* than to *Scrobipalpula*, *Keiferia* and *Phthorimaea*. Line from O_2 to A_3 usually outside ocellus I, or only touching it. Mandible with anterior seta L_3 distinctly longer than M_3. Antennal joint nearly as broad as long. Terminal papillae of membranous maxillar lobus rather short. Hypopharyngeal part of labium short subspherical, spinneret not substantially longer than labial palpi. Prothoracic shield with distinct medial sulcus. Seta II_a of shield is usually longest, together with seta II. Mesothoracic and metathoracic setae I

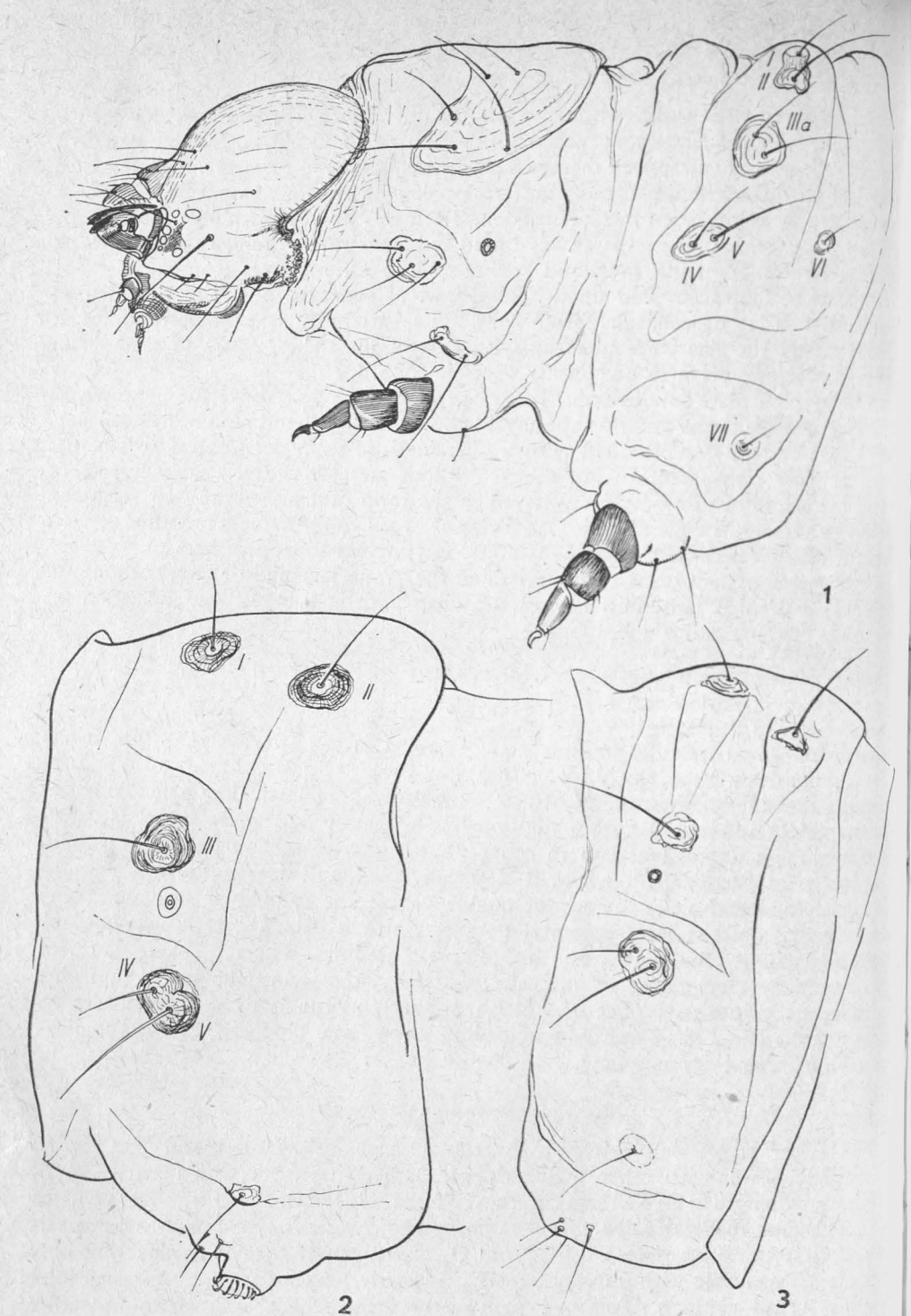

Table 1. *Srobipalpopsis solanivora* sp. n.: fig. 1 — Lateral view of larval head and the first two thoracic segments; fig. 2 — Lateral view of fourth abd. segment; fig. 3 — same view of second abd. segment.

and II are situated on the same tubercle, similarly as setae III and III_a. Tubercle with seta VI forming a nearly symmetric triangle with tubercles of setae III, III_a and IV, V. Chaetotaxy of second and fourth abdominal segments is similar as in other *Gnorimoschemini*. On eighth abdominal segment, the tubercle of group VII is unisetose. On nineth abdominal segment, the tubercle with seta III is rather small and weakly pigmented, the tubercle with the group of setae IV, V, VI is bisetose (seta VI lacking). No specific positions of setae on supraanal tergite.

The larvae are remarkable both in size, and colouration, and also in the distinctive setose tubercles, representing the biggest known larvae of this tribe. The chief specific characters (probably also of generic value) are the position of seta I, II on the same (one) tubercle of the second and third thoracic segment, and the reduction of seta III and the absence of seta VI on the ninth abdominal segment.

Systematic position

Scrobipalpopsis solanivora sp. n. appears to be closely related to *Scrobipalpopsis petasitis* (Pfaff.) and *S. tetradymiella* (Busck). It shows, hence, characters quite typical of the genus *Scrobipalpopsis* Povolný being its fifth known species. These affinities are seen best in genitalia of both sexes. *S. solanivora* differs from *S. tetradymiella* in having an obtusely tipped uncus, a heavier gnathos, a quite different form of parabasal processes of the valvae and in the paired process of the sacculus. The teguminal corners are more prominent and aedeagus visibly longer and straight. Female subgenital plate is quite different from *S. tetradymiella*, but similar to *S. petasitis*. It has a paired crescent sclerite and is more membranous than in *S. petasitis*, the signum bursae being more thorn-like. The related characters are of generic level only. Habitually, *S. solanivora* sp. n. is charaterised by its more prominent wing pattern, having the trinity of spots present (absent in *S. tetradymiella*), and it differs also in colouration (being brown, not grey as *S. tetradymiella*). The character of its wing pattern synthetises elements of both *S. tetradymiella* and *S. petasitis*.

In the larva, a similar position of setae I, II on thoracic segments is known in certain other gelechioid genera (e. g. *Stenolechia* Meyr., *Acanthophila* Hein.) and in related families (*Oecophoridae*, *Ethmiidae*), but also in other evolution branches of moths (e. g. *Pyralidae*). Compared with the distinctive sculpture of the integument and other chaetotaxy, this seems to be a more generalised character. Unfortunately, we are lacking in detailed descriptions of larvae of this genus. All we know is their general colouration (grey to yellowish) and their manner of life (they live in large leaf mines or produce galls). The larva of *S. solanivora* represents, however, a more primitive caterpillar than the larvae of other gnorimoschemoid genera (e. g. *Phthorimaea operculella*, with its reduced tubercles and setae). This is conform with the rather plesiomorphic character of the imagoes.

Phylogeny

The existence of *Scrobipalposis solanivora* sp. n.-a species, which displays characters very typical of the genus *Scrobipalpopsis*, as described in its original diagnosis (Povolný, 1967), confirms the taxonomic status of this genus as a monophyletic and, consequently, a natural taxon. It also supports the conclusion that the genus *Scrobipalpa* Janse was originally absent from the New World, and that the species *Scrobipalpa atriplicella* (F. v. R.) and *Scrobipalpa obsoletella* (F. v. R.) had been introduced into America (Keifer, 1936; Povolný, 1967). *Scrobipalpa* Janse and *Scrobipalpopsis* Povolný represent two

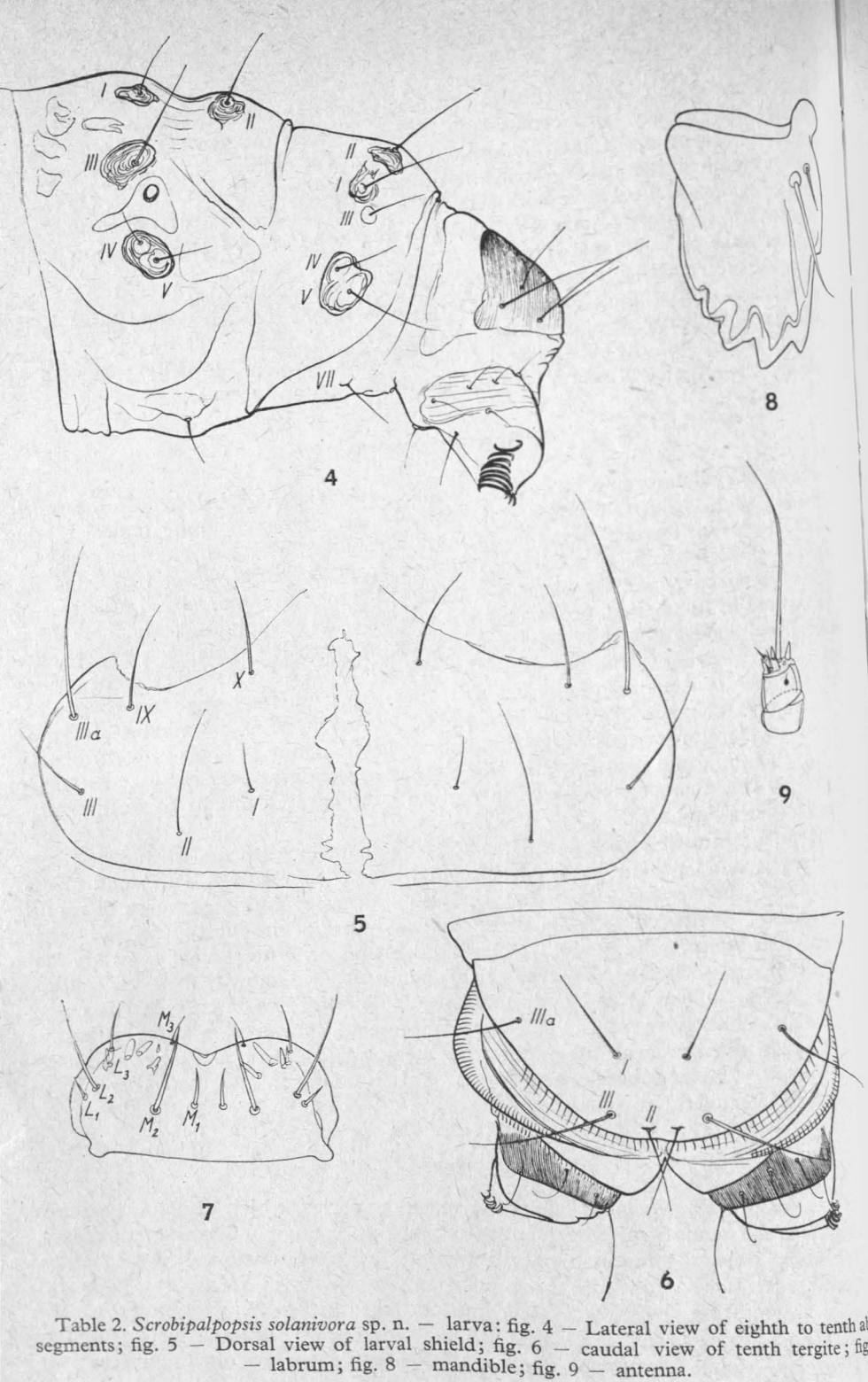

Table 2. *Scrobipalpopsis solanivora* sp. n. — larva: fig. 4 — Lateral view of eighth to tenth abd. segments; fig. 5 — Dorsal view of larval shield; fig. 6 — caudal view of tenth tergite; fig. 7 — labrum; fig. 8 — mandible; fig. 9 — antenna.

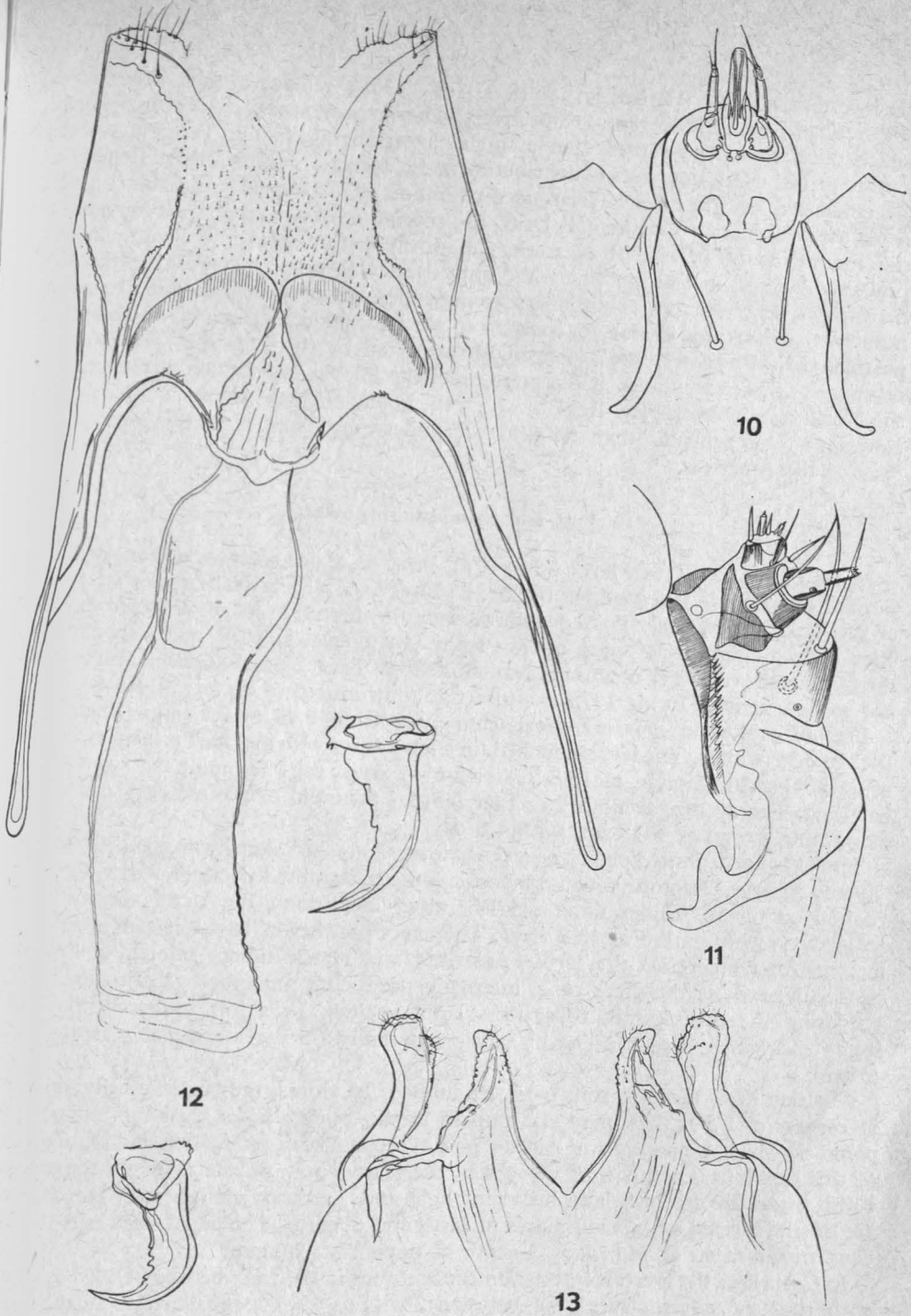

Table 3. *Scrobipalpopsis solanivora* sp. n.: fig. 10 — spinneret; fig. 11 — maxilla; fig. 12 — female genitalia (subgenital plate, with two types of signum bursae); fig. 13 — paired processes of male genitalia (see fig. 17).

„Schwestergruppen" (Hennig, 1960; Illies, 1965) replacing each other in the Palearctic and Nearctic Regions, respectively. They represent a very close morphotype, which once must have represented a single taxon having, in the Tertiary, probably a more or less continuous area of distribution in the dryland of the Northern Hemisphere (as evidenced by the recent Holarctic distribution of *Scrobipalpopsis petasitis* [Paff.]). After the Wegenerian Continental Drift, the speciation of *Scrobipalpopsis* continued in the mountains of (Western) Nearctic America penetrating to the South, but was probably stopped in Europe where the only species *S. petasitis* survived in the Alps. *Scrobipalpa* represents an evolutionary younger branch of *Scrobipalpopsis* manifesting numerous apomorphic characters contrary to plesiomorphic *Scrobipalpopsis*. This theory postulated by Povolný, 1967 is strongly supported by the finding of *Scrobipalpopsis solanivora* sp. n., extending, at the same time, the known distribution of this genus to the North of the Neotropical Region, where the genus might be restericted to mountain elevations. It is probable that more, as yet undescribed species of this genus might exist in the Americas.

Ecology and economic importance

In his recent letter (of March 30th, 1973) Prof. G. Fuentes provided important information, based on investigation by Mr. R. Barroso, who is dealing with the ecology of this striking new pest. To this information, the insect was first observed in Costa Rica after a shipment of seed potatos from Guatemala, in 1970, and since extended throughout the region of potato cultivation in Costa Rica, being in Guatemala obviously not so destructive. During 1973, the insect was introduced to Panama (Fuentes).

Freshly oviposited eggs are pearl white measuring 0.46 to 0.63 mm (lenght) and 0.43 to 0.39 (width). The larvae hatched (in a laboratory with maximal mean temperature of 22.1 °C and minimum of 18.8 °C) after 6—7 days, eggs becoming mat white before hatching. The average fecundity of four females was 190 oviposited eggs, one female ovipositing a total of 301 eggs, within 8 days.

The eggs are deposited on soil near the base of plants, occasionally on plants themselves (mainly foliage). Oviposition could be observed also on stored potatoes, where eggs were posited on tubers. Under described laboratory conditions, the larval stage lasts 13 to 15 days, with a mean of 13.8 days. The exact number of larval instars is still unknown. After emerging, the larvae penetrate and attack tubers mining, at first superficially, and, at the same time, internally producing numerous galleries and finally rendering the tubers, and, thus, the plants useless. In a few instances, the base, stems and leaves were attacked by larvae externally (larvae mining only in the first instar).

Pupation takes place in soil, near the surface. In stores, the larvae usually spin up in corners etc., but they may also pupate in the burlap sacks used for transporting potatoes, which is an easy and fast method of secondary dissemination and introduction of this pest into new areas. In rase cases, the larvae may pupate in or on the tubers. Fresh pupae are greenish later becoming light and, gradually, dark brown. The cocoons are of silk, covered with small pieces of earth and detritus. The pupal stage lasts 13—15 days with a mean of 14.6 days. Length of pupa 7.3—9.0 mm.

In Costa Rica the greatest infestation concentrates in the zone between 1,300—2,300 m with the temperatures averaging between 23 °C to 19 °C, respectively. In the zone above 2,600 m, with a mean temperature between 19.4 °C to 8.6 °C the infestation is less severe.

In the year 1972, the total area of potato growing representing approximately 2,000 ha

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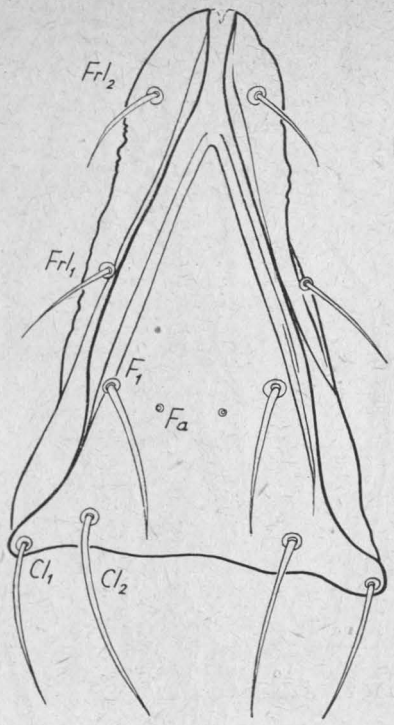

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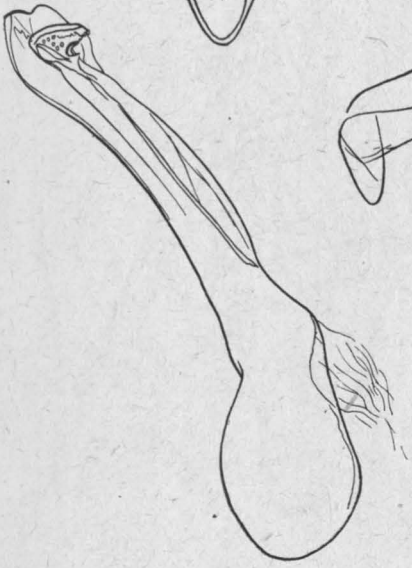

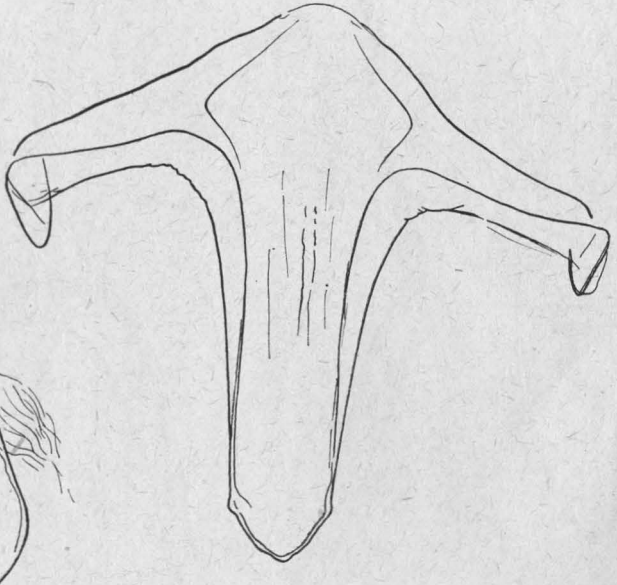

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Table 4. *Scrobipalpopsis solanivora* sp. n.: fig. 14 — male genitalia of *Scrobipalpopsis tetradymiella:* fig. 15 — saccus of *Scrobipalpopsis solanivora* (see fig. 17); fig. 16 — larval frons of *S. solanivora* sp. n.

Table 5. *Scrobipalpopsis solanivora sp. n.*: fig. 17 — male genitalia.

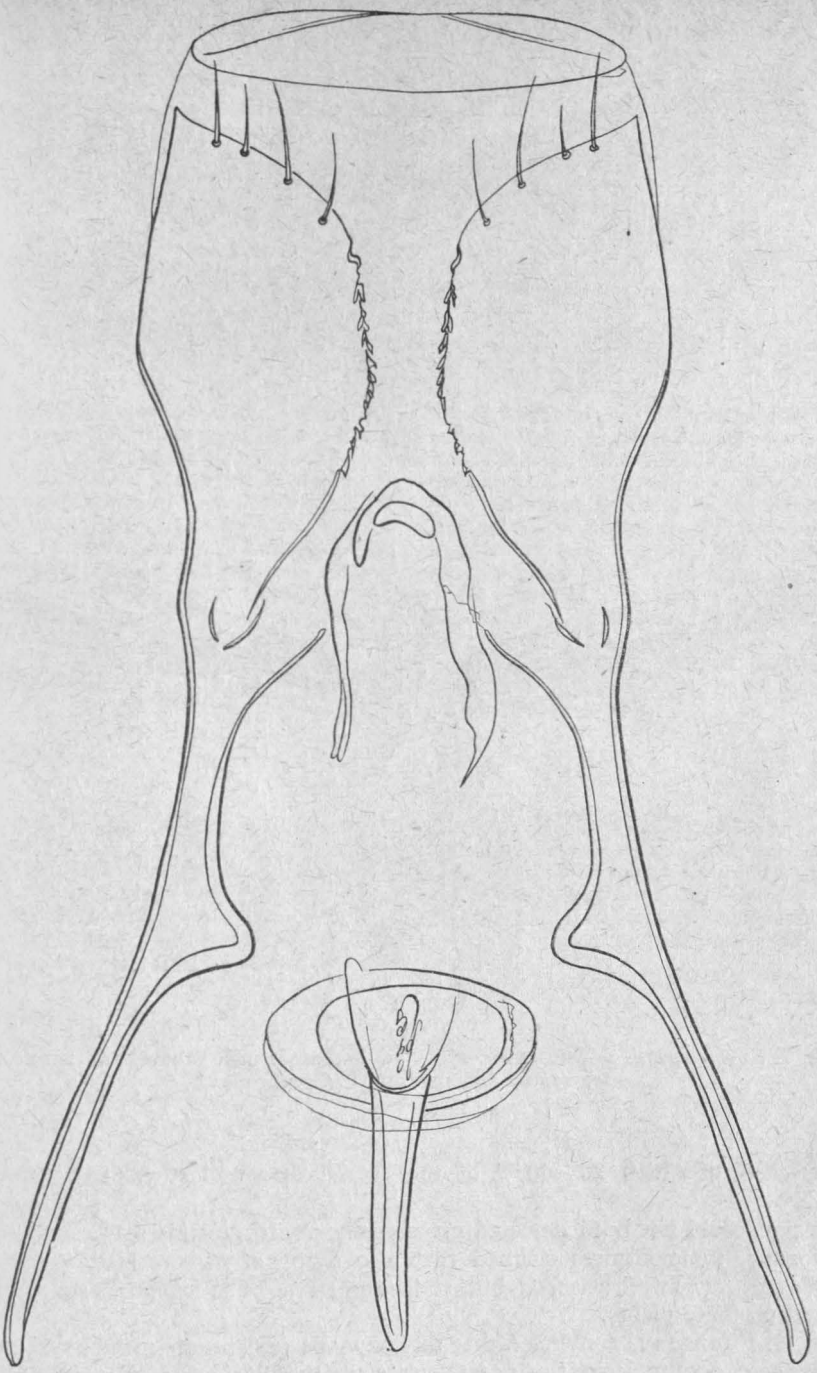

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Table 6. *Scrobipalpopsis petasitis:* fig. 18 — female genitalia (subgenital plate and signum bursae).

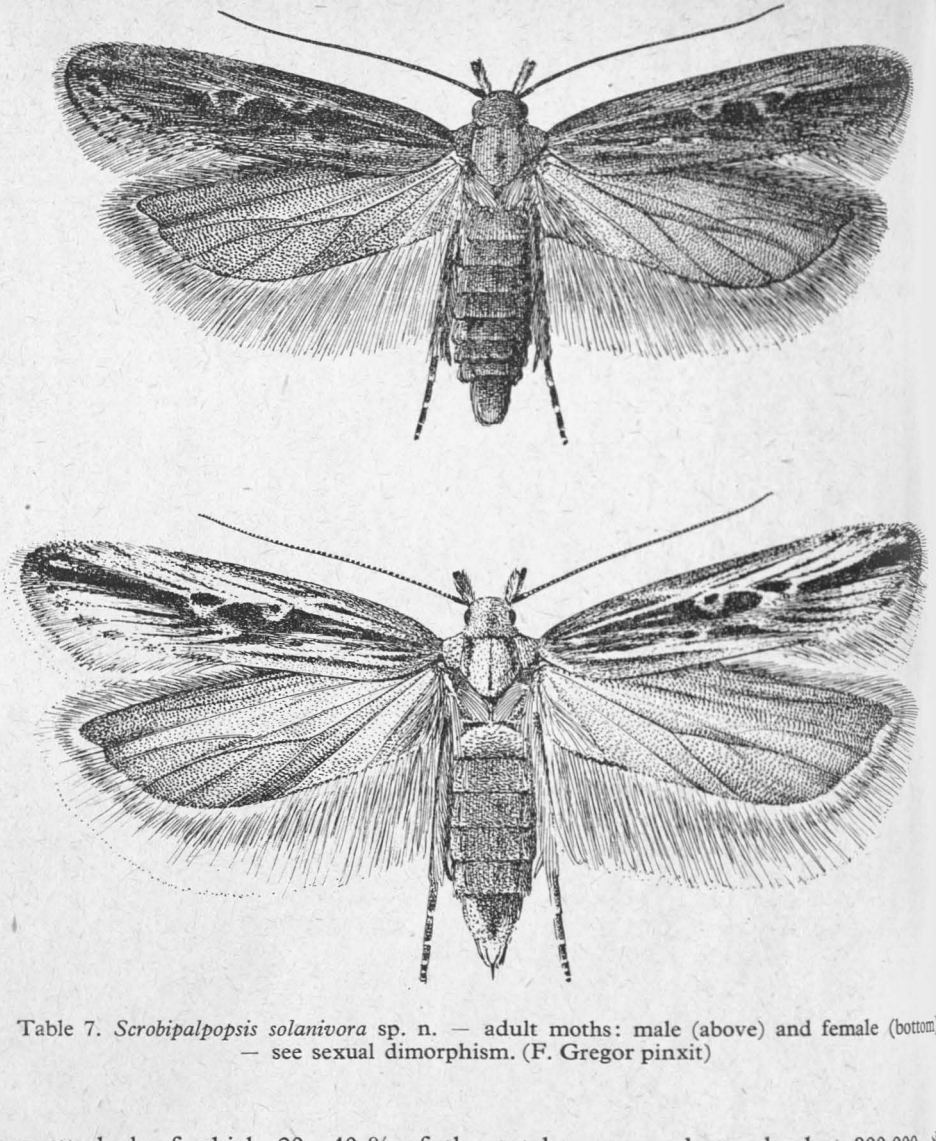

Table 7. *Scrobipalpopsis solanivora* sp. n. — adult moths: male (above) and female (bottom) — see sexual dimorphism. (F. Gregor pinxit)

was attacked, of which 20—40 % of the total crop was lost valued at 900,000.-$ (U. S.).

The pest could not been detected on any other wild growing species of *Solanaceae*. Occasionally, some farmers claimed that also crops of carrots (*Daucus carota*) and beet (*Beta vulgaris*) were attacked, but, so far, no larvae of *S. solanivora* sp. n. have been collected on these plants.

Prof. G. Fuentes is convinced that this new species appears to be more important, as a pest of potato, than the potato-tuber moth [*Phthorimaea operculella* (Zell.)], which has hitherto been the most important lepidopterous pest of potato.

This data on the ecology and economic importance of this new pest seem to warrant that this insect should be added to the International List of Quarantine Pests of

potato, especially in view of its introduction to Costa Rica from Guatemala. The species and genus are obviously Nearctic to Neotropical, presumably originating from some mountain range in Western America and feeding on endemic *Solanaceae*.

Material

Holotype ♂, Costa Rica, Llano Grande, Province Cartago, 24. 10. 72, leg. Gilbert Fuentes; Paratypes 5♂♂, 4♀♀, same data; 15♂♂, 15♀♀, same locality, 10. 1. 1973, leg. Gilbert Fuentes. Host plant: „Potato Tuber". The above material has been selected from non-preparated specimens packed in tubes or paper.

SOUHRN

Autor popisuje dosud neznámého kalamitního škůdce brambor ze Střední Ameriky (Costa Rica) – makadlovku *Scrobipalpopsis solanivora* sp. n. Materiál škůdce byl zaslán autorovi na podzim r. 1972 prof. Gilbertem Fuentesem (Departamento de Entomologia, Faculdad de Agronomia, Universidad de Costa Rica, San José) s žádostí o určení, neboť mohl byl zaměňován s makadlovkou bramborovou *(Phthorimaea operculella* Zell.), jež je původně novosvětským, druhotně v subtropech a tropech zkosmopolitněným škůdcem brambor. Studium materiálu housenek i dospělců vedlo ke zjištění, že tento škůdce je dosud neznámým druhem, který autor popisuje. Nový druh je příslušníkem převážně nearktického rodu *Scrobipalpopsis* Povolný, 1957, jehož jeden druh - *Scrobipalpopsis petasitis* (Ptaff.) - se kromě U.S.A. vyskytuje též v evropských Alpách. Tento rod sdružuje velké formy tribu *Gnorimoschemini*, jež buď minují *(S. petasitis)* nebo vytvářejí hálky *(S. tetradymiella)* na složnokvětých. Nový druh je první formou tohoto rodu, jenž je škůdcem brambor. Je největším známým druhem tohoto rodu i celého tribu. Dospělci jsou nápadní pohlavním dimorfismem, pro kresbu je charakteristická trojice skvrn uprostřed křídla a podélné paprsčité „žilkování" předních křídel. Samci jsou výrazně tmaví, samice světlé. Housenka je šarlatově červená a má poměrně primitivní chaetotaxi.

Pokud jde o ekologii škůdce, bylo zjištěno, že byl zavlečen do Costa Ricy zásilkou sadbových brambor z Guatemaly. V r. 1972 napadl ve výškách 1300–2300 m (s průměrnou teplotou cca 21 °C) výměru 2000 ha, kde došlo ke zničení kultur brambor asi z 20–40 %, což představuje škodu asi 900 tisíc dolarů (U.S.). Housenky provrtávají hlavně hlízy, méně často jsou napadeny i nadzemní části. Kuklí se mělce v půdě. Bylo však pozorováno i napadení uskladněných hlíz; housenky se kuklily i ve skladech, popřípadě v pytlích s brambory určenými k transportu. Celkový vývoj škůdce od vajíčka po dospělý hmyz trvá asi 5 týdnů. Škody jsou závažnější než u tzv. makadlovky bramborové [*Phthorimaea operculella* (Zell.)] považované dosud za nejvýznamnějšího motýlího škůdce brambor. Vzhledem k povaze bionomie škůdce je záhodno uvažovat o jeho zařazení do Mezinárodního seznamu karanténních škůdců brambor.

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СОДЕРЖАНИЕ

Автор описывает новый вид рода *Scrobipalpopsis* Povolný, 1967 из Коста Рики (Средняя Америка) Материал этого вида считаемый, возможно, «картофельной молью» *[Phthorimaea operculella* (Zell.)], был автору прислан для нового определения. Изучение личинок и взрослого насекомого вело к открытию до сих пор не знакомого вида, который описывается как *Scrobipalpopsis solanivora* sp. n. Как моли, так и личинки отличаются своей величиной, рисунком крыльев и окраской, но показывают ряд специфических морфологических признаков. Новый вид является самой большой известной формой рода *Scrobipalpopsis,* показывающий определенные отношения к *Scrobipalpopsis petasitis* расширенные в Северной Америке и в европейских Альпах и к *S. tetradymiella* из Калифорнии, но имеющий одновременно ряд вполне самостоятельных признаков.

Что касается экологии вредителя, было установлено, что он был ввезен в Коста Рику с грузом семенного картофеля из Гватемалы. В 1972 г. поражение этим вредителем произошло на высоте 1300—2300 м (со средней температурой около 21 ° С) на площади 2000 га, где погибло приблизительно от 20—40 % культур картофеля, что составляет приблизительно 900 000 долларов. Гусеницы провертываются главным образом клубнем, менее часто поражаются надземные части. Закукливание происходит в мелкой почве. Наблюдалось и поражение клубней картофеля в складках, гусеницы закукливались в складках или же в мешках с картофелем приготовленных для транспорта. Общее развитие вредителя от яичка к взрослому насекомому происходит в течение 5 недель. Вред значительнее, чем у так называемой моли картофельной *[Phthorimaea operculella* (Zell.)], считаемой до сих пор за самого важного мотылькового вредителя картофеля. Имея ввиду характер биономии вредителя возникает необходимость внести этого вредителя в Международный список карантинных вредителей картофеля.

Notice: The type specimens are deposited in: Department of Entomology, Moravian Museum, Brno; Department of Entomology, British Museum (Nat. Hist.), London; Department of Entomology, U. S. National Museum, Washington D. C..

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