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SALVATORE BELLA (*)

THE BOX TREE MOTH *CYDALIMA PERSPECTALIS* (WALKER, 1859) CONTINUES TO SPREAD IN SOUTHERN EUROPE: NEW RECORDS FOR ITALY (LEPIDOPTERA PYRALOIDEA CRAMBIDAE)

(*) *Dipartimento di Gestione dei Sistemi Agroalimentari e Ambientali (DiGeSA), Sez. Entomologia applicata, Università degli Studi di Catania, Via Santa Sofia 100, 95123 Catania, Italy;* e-mail: sbella@unict.it.

Bella S. – The box tree moth *Cydalima perspectalis* (Walker, 1859) continues to spread in southern Europe: new records for Italy (Lepidoptera Pyraloidea Crambidae).

The Box Tree Moth *Cydalima perspectalis* (Walker, 1859) is an invasive alien species whose original range is in eastern Asia on *Buxus* species. In Europe, it was first reported in 2006 in Germany, rapidly becoming widespread across the European Union. The danger they present is that larvae develop on commonly planted ornamental bushes *Buxus sempervirens* L.

This work provides an update of *Cydalima perspectalis* geographic distribution in Italy as well as including new records from Tuscany and the first record from Sicily.

KEY WORDS: *Cydalima perspectalis*, invasive species, *Buxus*, new record, Italy.

INTRODUCTION

Biological invasions by alien species are a great ecological and economic threat, with a multitude of negative impacts on human and animal health, local biodiversity (flora and fauna) and cultural landscapes. In Europe, insects are one of the taxonomic groups with the most alien species which cause economic impacts (HULME & ROY, 2010). In fact, the introduction of alien insects is a growing worldwide phenomenon, especially in countries with intensive international movement of goods and people.

Referring in particular to the order Lepidoptera, 74% of aliens insects in Europe were established during the 20th century and new arrivals are growing, with an average of 1.9 alien Lepidoptera newly established per year between 2000-2007 (LOPEZ-VAAMONDE *et al.*, 2010).

Analysis of the 78 alien Lepidoptera species whose origins are known, shows that Asia has contributed most with 28.9%, followed by Africa (including Macaronesian islands, Canaries, Madeira and Azores) with 21.6%, North America with 16.5%, Australasia with 7.2% and the Neotropics with 5.2% (LOPEZ-VAAMONDE *et al.,* 2010). This largely phytophagous insect group, is particularly affected by the increasing trade in plants and stored plant products.

A recent case is the Box Tree Moth *Cydalima perspectalis* (Walker, 1859), a species from East Asia, which was recorded for the first time in Europe in 2006 in south-western Germany, where it most probably arrived with *Buxus* seedlings (KRÜGER, 2008).

This species, originally described as *Phakellura perspectalis* Walker, 1859 has been placed in various spilomeline genera including *Palpita* Hübner, 1808, *Diaphania* Hübner, 1818 and *Glyphodes* Guenée, 1854. Based on phylogenetic analysis, the Box Tree Moth has been transferred to *Cydalima* Lederer, 1863; since *perspectalis* is the type-species of *Neoglyphodes* Streltzov, 2008, this genus name can be synonymised with *Cydalima* (MALLY & NUSS, 2010).

The moth is native to subtropical regions of eastern Asia (India, China, Korea, Japan and the Russian Far East) (INOUE *et al.,* 1982; LERAUT, 2012). In Europe, after its first record it spread quickly to many other countries, including United Kingdom, the Netherlands, Denmark, Liechtenstein, France, Belgium, Switzerland, Austria, Italy, Croatia, Romania, Hungary, Slovenia, Slovakia and Turkey (KOREN & ČRNE, 2012; PASTORÁLIS *et al.*, 2013) (for details see Table 1).

Cydalima perspectalis larvae feed on the leaves of different species of *Buxus*, seriously damaging these ornamental plants in private and public gardens as well as in semi-natural box-tree forests. In addition to the leaves, the larvae can attack the tree-bark, causing the trees to dry out and die. Due to its economic importance in East Asia, this species has been well investigated biologically and ecologically, resulting in its chemical and biological control by nematodes and its pheromones (ZHOU *et al.,* 2005; MALLY & NUSS, 2010). However, little was known about it in Europe before its arrival, because most of its research was published in Asian languages (EPPO, 2012).

This work provides an update of the Box Tree Moth *C. perspectalis* distribution in Italy with new records from Tuscany and the first record from Sicily.

IDENTIFICATION OF *CYDALIMA PERSPECTALIS*

In adults, the most common colour form has white, slightly iridescent wings with a large dark brown band at the outer margin and a characteristic white spot on the forewing, in the discoidal cell (Fig. I). Hindwings are white with the same band at the outer margin as in the forewings (MALLY & NUSS, 2010). In a less common colour variant, the adults are completely brown, but still show a white forewing spot. The moths have a wingspan of around 4

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Table 1 – Countries, year of discovery and references of *Cydalima perspectalis* in Europe.

Country	Year of discovery	References
Switzerland	2007	Billen, 2007
Germany	2006	Krüger, 2008
Netherlands	2007	Muus *et al.,* 2009
Austria	2008	Rodeland, 2009
France	2008	Feldtrauer *et al.,* 2009
United Kingdom, Ireland	2008	Mitchell, 2009
Liechtenstein	2010	Slamka, 2010
Belgium	2010	Casteels *et al.,* 2011; De Prins & Steeman 2011
Italy	2010	FEI, 2012a
Hungary	2011	Sáfián & Horváth, 2011; Szabolcs & Bálint, 2011
Czech Republic	2011	Šumpich, 2011
Romania	2011	Székely *et al.,* 2011
Slovenia	2008	Seljak, 2012
Turkey	2011	Hizal *et al.,* 2012
Croatia	2012	Koren & rne, 2012
Slovakia	2013	Pastorális *et al.,* 2013
Denmark	2013	Hobern, 2013

cm, they are good flyers and can reach a lifespan of up to two weeks.

Eggs are laid on the leaves of the host plant in groups of 5-20, coated with a translucent jelly (Leuthardt & Baur, 2013). When first laid, the eggs are pale yellow, but close to hatching, the black heads of the larvae are visible. The light green larvae are characterized by black stripes with white dots and hairs and a shiny black head; in the last larval stage they can reach a length of up to 4 cm (CABI, 2013).

The pupae are between 1.5 and 2.0 cm long. Initially green with dark stripes on the dorsal surface, towards the end of pupation they turn brown with a dark pattern corresponding to the brown wing borders of the adult. They are concealed in a cocoon of white silk spun among the leaves and twigs (Korycinska & Eyre, 2009).

HOST PLANT

The host plants of *Cydalima perspectalis* are *Buxus* spp.: *B. sempervirens* L., *B. microphylla* Siebold & Zucc., *B. sinica* (Rehder & E. H. Wils.) M. Cheng and *B. colchica* Pojark (Buxaceae). In its origin countries, it has also been reported on *Euonymus japonicus* Thunb., *E. alata* (Thunb.) Siebold (Celastraceae), *Ilex purpurea* Hassk. (Aquifoliaceae), *Pachysandra terminalis* Siebold & Zucc. and *Murraya paniculata* (L.) Jack (Rutaceae) where larvae feed on leaves and are considered serious defoliators (Korycinska & Eyre, 2009; Wang, 2008); there are no current reports of these plant species being attacked in Europe (CABI, 2013).

The genus *Buxus* encompasses about 100 species, distributed in two major centers of diversity (Caribbean-

Fig. I – *Cydalima perspectalis*, adult.

Latin America and East Asia) and a minor one (Africa). The Asian section (*Eubuxus*) includes the "Mediterranean" taxa *Buxus sempervirens* and *Buxus balearica* Lam. *B. sempervirens* is an evergreen tree or shrub, that occurs in a large part of Europe (Portugal, Spain, France, United Kingdom, Ireland, Germany, Belgium, Luxembourg, Switzerland, Austria, Italy, Slovenia, Croatia, Montenegro, Macedonia, Albania, Serbia, Kosovo, Greece, Turkey). It lives in the wild in different habitats, in open garigues and forest areas (DI DOMENICO *et al.,* 2011).

In most parts of the Euro-Mediterranean region, *Buxus* spp. are also popular ornamental shrubs for garden and parks being extensively grown in nurseries and traded as potted plants or cuttings which confers on them a certain economic importance. *Cydalima perspectalis* may present a particularly serious threat to historical gardens, in which the box tree is commonly used as an important horticultural design plant (EPPO, 2012; SELJAK, 2012).

A recent study investigated the oviposition choice and larval food preference and performance on five commonly used European box-tree varieties: *B. sempervirens* 'Sempervirens', *B. s.* 'Rotundifolia', *B. s.* 'Argenteovariegata', *B. s.* 'Aureovariegata' and *B. microphylla* 'Faulkner'. The study showed that females prefer the variety 'Rotundifolia' for oviposition, but revealed no differences in larval growth rate and survival on the five varieties. However, a strong seasonal variation in larval performance was found, the spring generation growing faster than the autumn generation (LEUTHARDT & BAUR, 2013).

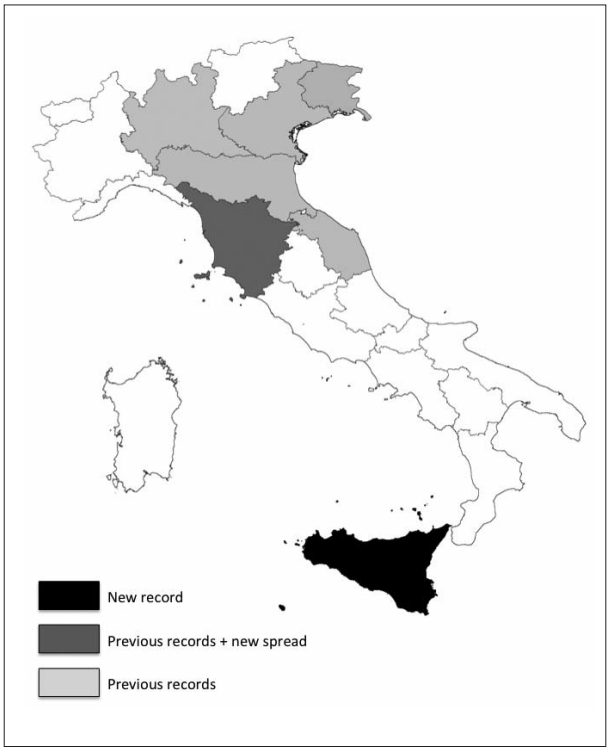

Fig. II – Distribution of *Cydalima perspectalis* in Italy.

DISTRIBUTION IN ITALY

In Italy, *Cydalima perspectalis* was first officially reported in the Lombardia region in Como province, in 2011 (GRIFFO *et al.,* 2012; TANTARDINI *et al.,* 2012). Very probably, the moth arrived there through Switzerland and is now spreading across the northern part of the region (Lecco and Varese provinces) (APFV, 2012).

Records of this species had already been available for the Veneto region (Padova and Vicenza provinces) since 2010 on national observers' websites (FEI, 2012a; STRAZZABOSCO, 2013). In 2012, it was also found in Friuli Venezia Giulia (Pordenone province) (GOVERNATORI, 2013), in Emilia Romagna (Reggio Emilia and Ravenna provinces) (FEI, 2012b; UHL & WÖLFLING, 2013), Tuscany (Pistoia province) (CESPEVI, 2012; VANARELLI *et al.,* 2013) and in Marche (Pesaro Urbino province) (FEI, 2013) (Fig. II).

NEW FINDING SITES

Larvae of *Cydalima perspectalis* were observed on plants of *Buxus sempervirens* 'Rotundifolia' in two Eastern Sicily locations: Aci Castello, m 44 a.s.l. (37°32'44"N; 15°08'10"E) and Catania, m 33 a.s.l. (37°32'17"N; 15°07'12"E), in Catania province. They were registered in nurseries from the beginning of April to the first week of May 2013. Larvae infested the young shoots of plants with damage on leaves and death of parts of the attacked plants.

Mature larvae and coconut were brought to the laboratory to the Department of Agri-food and Environmental Systems Management, University of Catania, for subsequent observation: 19 adults were obtained, respectively 11 females and 8 males. Only one specimen presented the completely brown colour variant.

The attacked Sicilian plants were imported from another nursery in (Pistoia) Tuscany which broadens the moth distribution for this region.

CONCLUSIVE REMARKS

Buxus is an economically important ornamental plant grown in nurseries, public gardens, historical parks and private gardens. Data available on the trade of *Buxus* plants provided by the Netherlands, Germany and Italy, show large increases in its importation in recent years, mainly from China (EPPO, 2012).

The newly established *Cydalima perspectalis* in Europe could represent a serious problem for landscaping and nursery production. It has been shown that the moth feeds on all of the most frequently planted box-tree species and varieties in Central Europe, suggesting that its dispersal across Europe is not limited by food resources (LEUTHARDT & BAUR, 2013). A climate model of the potential distribution of *C. perspectalis* in Europe suggests that the species will likely continue its spread across Europe, except for Northern Fenno-Scandinavia and high mountain regions (NACAMBO *et al.,* 2013).

The species frequently impacts on the quality of ornamental plants and leads to economic losses. Moreover, it seems to have a potentially important ecological impact: it caused significant damage to large areas (> 100 ha) of naturally growing box tree forests in Switzerland during one single summer (LEUTHARDT & RAMIN, 2011) and could threaten wild *Buxus* in Europe. In Italy, *B. sempervirens* is already suffering from fragmented distribution and population size reduction (DI DOMENICO *et al.,* 2011) and could be more prone to pest attacks.

The rapid colonization of European countries by the invasive moth is giving rise to a strong need to study its biology, ecology and population dynamics with a view to

better understanding its potential distribution and possible impact on both ornamental and natural box tree populations to assess effective management.

Recently, laboratory experiments have indicated the susceptibility of *C. perspectalis* larvae to baculovirus *Anagrapha falcifera* nucleopolyhedrovirus (AnfaNPV) as a new opportunity to control this pest (Rose *et al.,* 2013).

However, the new finding in Sicily on infested plants imported from a region where the insect was already present, not only confirms once again that the ornamental pathway is the most important for alien arthropods in Europe (Rabitsch, 2010), but also emphasizes the need for controls and inspections of traded goods as a preventive management method.

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REFERENCES

APFV, 2012 – Cydalima perspectalis *(Piralide del bosso).* - Il Laboratorio Fitopatologico. Aggiornamenti Fitopatologici (Associazione dei Produttori Florovivaisti Varesini), 4: 1-4.

Billen W., 2007 – Diaphania perspectalis *(Lepidoptera: Pyralidae) - a new moth in Europe.* - Mitteilungen der Entomologischen Gesellschaft Basel, 57 (2/4): 135-137.

CABI, 2013 - Cydalima perspectalis (*Box tree moth*). - http://www.cabi.org/isc/?compid=5&dsid=118433&loadmodule=datasheet&page=481&site=144 [accessed 02.10.2013].

Casteels H., Witters J., Vandierendonck S., Van Remoortere L., 2011 – *First report of* Cydalima perspectalis *(Lepidoptera: Crambidae) in Belgium*. - 63 rd International Symposium on Crop Protection (poster presentation).

CESPEVI, 2012 – Centro Sperimentale per il Vivaismo (Ce.Spe.Vi.). - www.cespevi.it [accessed 08.09.2013].

De Prins W., Steeman C., 2011 – *Catalogue of the Lepidoptera of Belgium*. -
http://webh01.ua.ac.be/vve/Checklists/Lepidoptera/Lepmain.htm [accessed 15.10.2013].

Di Domenico F., Lucchese L., Magri D., 2011 – *Late glacial and holocene history of* Buxus sempervirens *L. in Italy*. - Annali di Botanica, 1: 45-58.

EPPO, 2012 – EPPO Technical Document No. 1061, EPPO Study on the Risk of Imports of Plants for Planting. EPPO Paris.

FEI, 2012a – *Forum Entomologi Italiani*. http://www.entomologiitaliani.net/public/forum/phpBB3/viewtopic.php?f=113&t=38922&hilit=cydalima [accessed 04.09.2013].

FEI, 2012b – *Forum Entomologi Italiani*. http://www.entomologiitaliani.net/public/forum/phpBB3/viewtopic.php?f=113&t=38824&hilit=cydalima [accessed 23.09.2013].

FEI, 2013 – *Forum Entomologi Italiani*. http://www.entomologiitaliani.net/public/forum/phpBB3/viewtopic.php?f=113&t=47901&hilit=cydalima [accessed 02.09.2013].

Feldtrauer J.F., Feldtrauer J.J., Brua C., 2009 – *Premiers signalements en France de la Pyrale du buis* Diaphania perspectalis (Walker, 1859), *espèce exotique envahissante s'attaquant aux buis (Lepidoptera, Crambidae).* - Bulletin de la Société entomologique de Mulhouse, 65: 55-58.

Governatori G., 2013 – *La piralide del bosso* (Cydalima perspectalis) *in Friuli Venezia Giulia.* - Notiziario Ersa, 1: 35-37.

Griffo R., Cesaroni C., Desantis M., 2012 – *Organismi nocivi introdotti in Italia nell'ultimo triennio.* - Informatore Agrario, 68 (25): 61-63.

Hizal E., Kose M., Yesil C., Kaynar D., 2012 – *The New Pest* Cydalima perspectalis *(Walker, 1859) (Lepidoptera: Crambidae) in Turkey*. - Journal of Animal and Veterinary Advances, 11 (3): 400-403.

Hobern D., 2013 – Cydalima perspectalis *(Walker, 1859).* http://www.flickr.com/photos/dhobern/9418970083/ [accessed 18.11.2013].

Hulme P.E., Roy D.B., 2010 – DAISIE *and arthropod invasions in Europe p. 1-3.* In: Roques A. et al. (Eds), Alien terrestrial arthropods of Europe. – BioRisk, 4(1).

Inoue H., 1982 – *Pyralidae*. In: Inoue H., Sugi S., Kuroko H., Moriuti S. & Kawabe A. (eds): Moths of Japan 1, 2. Kodansha, Tokyo, pp. 307-404 (vol. 1), 223-254; pls 36-48, 228, 296-314 (vol. 2).

Koren T., Črne M., 2012 – *The first record of the box tree moth*, Cydalima perspectalis *(Walker, 1859) (Lepidoptera, Crambidae) in Croatia*. - Natura Croatica, 21 (2): 507-510.

Korycinska A., Eyre D., 2009 – *Box tree caterpillar*, Diaphania perspectalis. FERA Plant pest fact-sheet. http://www.fera.defra.gov.uk/ plants/plantHealth/pestsDiseases/documents/boxTree-Caterpillar.pdf [accessed 28.09.2013].

Krüger E.O., 2008 – Glyphodes perspectalis *(Walker, 1859) – neu für die Fauna Europas (Lepidoptera: Crambidae).* - Entomologische Zeitschrift, 118 (2): 81-83.

Leraut P., 2012 – *Moths of Europe Zygaenids, Pyralids 1*, Volume 3, Nap. Editions, 600 pp.

Leuthardt F.L.G., Baur B., 2013 – *Oviposition preference and larval development of the invasive moth* Cydalima perspectalis *on five European box-tree varieties*. - Journal of Applied Entomology, 137: 437-444.

Leuthardt F.L.G., Ramin S., 2011 – *The Box-Tree Pyralid* Diaphania perspectalis - *Occurrence, Dispersal and Impact of an Invasive Species in Switzerland*. - Jahrbuch der Baumpflege, 255-260.

Lopez-Vaamonde C., Agassiz D., Augustin S., De Prins J., De Prins W., Gomboc S., Ivinskis P., Karsholt O., Koutroumpas A., Koutroumpa F., Lašt vka Z., Marabuto E., Olivella E., Przybylowicz L., Roques A., Ryrholm N., Šefrová H., Šima P., Sims I., Sinev S., Skulev B., Tomov R., Zilli A., Lees D., 2010 – *Lepidoptera,* chapter 11, p. 603-668. In: Roques A. et al. (Eds), Alien terrestrial arthropods of Europe. BioRisk, 4 (2).

Mally R., Nuss M., 2010 – *Phylogeny and nomenclature of the box tree moth,* Cydalima perspectalis *(Walker, 1859) comb. n., which was recently introduced into Europe (Lepidoptera: Pyraloidea: Crambidae: Spilomelinae).* - European Journal of Entomology, 107: 393-400.

Mitchell A., 2009 – *Box tree moth* Diaphania perspectalis (Walk.) – *a new pyralid moth to Britain and Ireland.* - Atropos, 36: 17-18.

Muus T.S.T., Haaften E.-J. Van, Deventer L.J. Van, 2009 – *De buxusmot* Palpita perspectalis *(Walker) in Nederland (Lepidoptera: Crambidae*). - Entomologische Berichten, 69 (2): 66-67.

NACAMBO S., LEUTHARDT F.L.G., WAN H., LI H., HAYE T., BAUR B., WEISS R.M., KENIS M., 2013 – *Development characteristics of the box-tree moth* Cydalima perspectalis *and its potential distribution in Europe*. - Journal of Applied Entomology, doi: 10.1111/jen.12078.

PASTORÁLIS G., ELSNER G., KOPEÈEK F., KOSORÍN F., LAŠTÙVKA A., LENDEL A., LIŠKA J., NÌMÝ J., RICHTER I., ŠTEFANOVIÈ R., ŠUMPICH J., TOKÁR Z., 2013 – *Fourteen Lepidoptera species new to the fauna of Slovakia*. - Folia faunistica Slovaca, 18 (1): 1-12.

RABITSCH W., 2010 – *Pathways and vectors of alien arthropods in Europe*. Chapter 3. In: Roques A. et al. (Eds) Alien terrestrial arthropods of Europe. BioRisk, 4(1): 27-43.

RODELAND J., 2009 – *Lepiforum: identification of Lepidoptera and their early stages*. www.lepiforum.de [accessed 22.08.2013].

ROSE J., KLEESPIES R.G., WANG Y., WENNMANN J.T., JEHLE J.A., 2013 – *On the susceptibility of the box tree moth* Cydalima perspectalis *to* Anagrapha falcifera *nucleopolyhedrovirus (AnfaNPV)*. - Journal of Invertebrate Pathology, 113 (3): 191-197.

SÁFIÁN S., HORVÁTH B., 2011 – *Tree Moth* Cydalima perspectalis (Walker, 1859), *new member in the Lepidoptera fauna of Hungary (Lepidoptera: Crambidae)*. - Natura Somogyiensis, 19: 245-246.

SELJAK G., 2012 – *Six new alien phytophagous insect species recorded in Slovenia in* 2011. - Acta Entomologica Slovenica, 20 (1): 31-44.

SLAMKA F., 2010 – *Pyraloidea (Lepidoptera) of Central Europe*. František Slamka,
Bratislava, 174 pp.

STRAZZABOSCO L., 2013 – Cydalima perspectalis. http://www.monzaflora.net/notiziarioweb/cydalima-perspectalis-la-piralide-del-bosso [accessed 16.10.2013].

ŠUMPICH J., 2011 – *Motýli Národních park Podyjí a Thayatal*. Znojmo, 428 pp.

SZABOLCS S., BÁLINT H., 2011 – *Box tree moth* - Cydalima *perspectalis (Walker, 1959), new member in the Lepidoptera fauna of Hungary (Lepidoptera: Crambidae).* - Natura Somogyiensis, 19: 245-246.

SZÉKELY L., DINC V., MIHAI C., 2011 – Cydalima perspectalis *(Walker, 1859), a new species for the Romanian fauna (Lepidoptera: Crambidae: Spilomelinae).* - Buletin de informare Entomologica, 22 (3-4): 73-78.

TANTARDINI A., CAVAGNA B., MASPERO M., 2012 – *Una nuova introduzione, Piralide del bosso.* - Acer, 4: 56-57.

UHL B., WÖLFLING B., 2013 – *New record of the invasive pest species* Cydalima perspectalis *(Walker, 1859) in Emilia Romagna (Italy) (Lepidoptera: Crambidae, Spilomelinae)*. - Nachrichten des Entomologischer Verein Apollo, N. F., 34 (1-2): 91-93.

VANARELLI S., RIZZO D., STEFANI L., PAOLI M., 2013 – *Piralide del bosso* Cydalima (Diaphania *o* Glyphodes) perspectalis (Walker, 1859). Regione Toscana. http://www.regione.toscana.it/-/servizio-fitosanitario-regionale-della-toscana [accessed 18.09.2013].

WANG Y.M., 2008 – *The biological character and control of a new pest* (Diaphania perspectalis) *on* Murraya paniculata. - Journal of Fujian Forestry Science and Technology, 4: 161-164.

ZHOU W., XIA C.-Y., SUN X.-Q., ZHU B., LIU X.-P., LIU Z.-C., WANG Y., 2005 – *Studies on the biological characteristics and control of* Diaphania perspectalis *Walker.* - Journal of Shanghai Jiaotong University - Agricultural Science, 23 (1): 52-56.