Prepared by CABI and EPPO for the EU under Contract 90/399003

Data Sheets on Quarantine Pests

Spodoptera littoralis and *Spodoptera litura*

IDENTITY

Taxonomic position: Insecta: Lepidoptera: Noctuidae
Notes on taxonomy and nomenclature: The two Old World cotton leafworm species *S. litura* and *S. littoralis* are allopatric, their ranges covering Asia and Africa, respectively. Many authors have regarded them as the same species. Though *S. littoralis* just enters the EPPO region while *S. litura* does not, they present virtually a common phytosanitary risk, requiring the same phytosanitary measures. They can conveniently be considered together in one data sheet.

- ***Spodoptera littoralis***
  Name: *Spodoptera littoralis* (Boisduval)
  Synonyms: *Hadena littoralis* Boisduval
  Common names: Cotton leafworm, Egyptian cottonworm, Mediterranean brocade moth (English)
  Noctuelle méditerranéenne (French)
  Afrikanischer Baumwollwurm (German)
  Rosquilla negra (Spanish)
  Bayer computer code: SPODLI
  EPPO A2 list: No. 120
  EU Annex designation: I/A2
- ***Spodoptera litura***
  Name: *Spodoptera litura* (Fabricius)
  Synonyms: *Prodenia litura* Fabricius
  Common names: Cotton leafworm, tobacco cutworm (English)
  Asiatischer Baumwollwurm (German)
  Bayer computer code: PRODLI
  EPPO A1 list: No. 42
  EU Annex designation: I/A1

HOSTS

Both species are totally polyphagous (Brown & Dewhurst, 1975; Holloway, 1989). The host range of each species covers over 40 families, that for *S. littoralis* containing at least 87 species of economic importance (Salama *et al*., 1970). Among the main crop species attacked by *S. litura* in the tropics are *Colocasia esculenta*, cotton, flax, groundnuts, jute, lucerne, maize, rice, soyabeans, tea, tobacco, vegetables (aubergines, *Brassica*, *Capsicum*, cucurbit vegetables, *Phaseolus*, potatoes, sweet potatoes, *Vigna* etc.). Other hosts include ornamentals, wild plants, weeds and shade trees (e.g. *Leucaena leucocephala*, the shade tree of cocoa plantations in Indonesia). In most of the EPPO region, outdoor crops are not likely to be attacked, so the principal potential hosts are ornamentals under glass. In the south of the region, cotton, lucerne, soyabeans, *Trifolium* and vegetables are hosts for *S. littoralis*, which is already present, and potentially also for *S. litura*.

GEOGRAPHICAL DISTRIBUTION

The ranges of the two species do not currently overlap and neither has extended its range (except in the special case of glasshouses in Europe).

- ***Spodoptera littoralis***

EPPO region: Widespread in Algeria, Cyprus, Egypt, Israel, Libya, Malta, Morocco, Spain; locally established in Greece, Italy (outdoors in the south and in glasshouses in the north), Portugal (south only), Tunisia; found but not established in Denmark, Finland, France, Germany, Netherlands, UK (England). Also reported from Lebanon, Syria and Turkey.

Asia: Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Lebanon, Oman, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen.

Africa: Algeria, Angola, Benin, Burkina Faso, Burundi, Botswana, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Egypt, Equatorial Guinea, Eritrea, Gambia, Ghana, Guinea, Kenya, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, St. Helena, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zaire, Zambia, Zimbabwe.

EU: Present.

Distribution map: See CIE (1967, No. 232).

- ***Spodoptera litura***

EPPO region: Russia (Far East), UK - found under glass in 1973 and eradicated (Aitkenhead *et al.*, 1974).

Asia: Afghanistan, Bangladesh, Brunei, Cambodia, China (widespread), Christmas Island, Hong Kong, Indonesia (widespread), India (widespread), Iran, Japan (widespread), Korea Democratic People's Republic, Korea Republic, Lao, Maldives, Malaysia (widespread), Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Viet Nam.

Africa: Réunion.

North America: USA (Hawaii only).

Oceania: American Samoa, Australia (Northern Territory, New South Wales, Queensland, Western Australia), Cocos Islands, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, New Caledonia, Niue, Norfolk Island, Northern Mariana Islands, Micronesia, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, Wallis and Futuna Islands.

EU: Absent.

Distribution map: See IIE (1993, No. 61).

BIOLOGY

Between 2 and 5 days after emergence, females lay 1000-2000 eggs in egg masses of 100-300 on the lower leaf surface of the host plant (Miyahara *et al*., 1971). The masses are covered by hair-like scales from the end of the insect's abdomen. Fecundity is adversely affected by high temperature and low humidity (about 960 eggs laid at 30°C and 90% RH and 145 eggs at 35°C and 30% RH). Newly laid eggs of one strain of *S. littoralis* were reported to survive exposure to 1°C for 8 days. Partially developed eggs survived longer than newly laid ones under equivalent conditions.

The eggs hatch in about 4 days in warm conditions, or up to 11-12 days in winter. The larvae pass through six instars in 15-23 days at 25-26°C. At lower temperatures, for example *S. littoralis* on glasshouse chrysanthemums in Europe, larvae often go through an

extra instar, and maturation may take up to 3 months. The young larvae (first to third instar) feed in groups, leaving the opposite epidermis of the leaf intact. Later, the (4th to 6th instar) larvae disperse and spend the day in the ground under the host plant, feeding at night and early in the morning.

The pupal period is spent in earthen cells in the soil and lasts about 11-13 days at 25°C. Longevity of adults is about 4-10 days, being reduced by high temperature and low humidity. Thus, the life cycle can be completed in about 5 weeks. In Japan (Nakasuji, 1976), four generations develop between May and October, while in the humid tropics there may be eight annual generations. In the seasonal tropics, several generations develop during the rainy season, while the dry season is survived in the pupal stage.

The development thresholds and thermal requirements of *S. litura* have been specified by Rao *et al.* (1989). For more information, see Bishara (1934), Schmutterer (1969), Salama *et al.* (1970), Cayrol (1972), Nasr (1973), Baker & Miller (1974), Shutova & Cheknonadskikh (1974), Cunningham & Broadley (1975).

DETECTION AND IDENTIFICATION

Symptoms

On most crops, damage arises from extensive feeding by larvae, leading to complete stripping of the plants.

On cotton

Leaves are heavily attacked and bolls have large holes in them from which yellowish-green to dark-green larval excrement protrudes.

On tobacco

Leaves develop irregular, brownish-red patches and the stem base may be gnawed off.

On maize

The stems are often mined and young grains in the ear may be injured.

Morphology

Eggs

Spherical, somewhat flattened, 0.6 mm in diameter, laid in batches and covered with hair scales from the tip of the abdomen of the female moth. Usually pale orange-brown or pink in colour (*S. litura*) or whitish-yellow (*S. littoralis*).

Larva

Attains 40-45 mm in length; hairless, variable in colour (blackish-grey to dark-green, becoming reddish-brown or whitish-yellow); sides of body with dark and light longitudinal bands; dorsal side with two dark semilunar spots laterally on each segment, except for the prothorax; spots on the first and eighth abdominal segments larger than others, interrupting the lateral lines on the first segment. Though the markings are variable, a bright-yellow stripe along the length of the dorsal surface is characteristic of *S. litura* larvae.

Pupa

15-20 mm long, red-brown; tip of abdomen with two small spines.

Adult

Moth, with grey-brown body, 15-20 mm long; wingspan 30-38 mm. The forewings are grey to reddish-brown with a strongly variegated pattern and paler lines along the veins (in males, bluish areas occur on the wing base and tip); the hindwings are greyish-white with grey margins, often with dark veins in *S. litura* but without in *S. littoralis*. The variability and similarity of the two species often make it difficult to distinguish them visually. On dissection of the genitalia, ductus and ostium bursae are the same length in female *littoralis*, different lengths in *litura*. The shape of the juxta in males is very characteristic, and the ornamentation of the aedengus vesica is also diagnostic.

For more information on the morphological discrimination between the adult, pupal and larval stages of the two species, see Mochida (1973). See also Schmutterer (1969), Cayrol (1972), Brown & Dewhurst (1975).

MEANS OF MOVEMENT AND DISPERSAL

The moths have a flight range of 1.5 km during a period of 4 h overnight, facilitating dispersion and oviposition on different hosts (Salama & Shoukry, 1972). They can accordingly fly quite long distances. In international trade, eggs or larvae may be present on planting material, cut flowers or vegetables. The introduction of *S. litura* into the UK was on aquatic plants imported from Singapore (Aitkenhead *et al*., 1974). *S. littoralis* has been trapped outside its normal range in Europe (Hachler, 1986), presumably as a result of entry on imported commodities.

PEST SIGNIFICANCE

Economic impact

S. litura is an extremely serious pest, the larvae of which can defoliate many economically important crops. In controlled experiments on soyabeans in India, crops chemically protected from *S. litura* and other pests yielded over 42% more than crops which were not sprayed (Srivastava *et al*., 1972). On tobacco, in India, it was estimated that two, four and eight larvae per plant reduced yield by 23-24, 44.2 and 50.4%, respectively (Patel *et al*., 1971). On *Colocasia esculenta*, an average of 4.8 4th-instar larvae per plant reduced yield by 10%, while 2.3 and 1.5 larvae reduced yield of aubergines and *Capsicum* in glasshouses by 10% also (Nakasuji & Matsuzaki, 1977).

S. littoralis is similarly one of the most destructive agricultural lepidopterous pests within its subtropical and tropical range. It can attack numerous economically important crops all the year round. On cotton, the pest may cause considerable damage by feeding on the leaves, fruiting points, flower buds and, occasionally, also on bolls. When groundnuts are infested, larvae select primarily the young folded leaves for feeding but, in severe attacks, leaves of any age are stripped off. Sometimes, even the ripening kernels in the pods in the soil may be attacked. Pods of cowpeas and the seeds they contain are also often badly damaged. In tomatoes, larvae bore into the fruit which is thus rendered unsuitable for consumption. Numerous other crops are attacked, mainly on their leaves.

In Europe, damage due to *S. littoralis* was minimal until about 1937. In 1949, there was a catastrophic larval population explosion in southern Spain. The main crops affected were lucerne, potatoes and other vegetable crops. At present, this noctuid is of great economic importance in Cyprus, Israel, Malta, Morocco and Spain (but not in the north, e.g. Cataluña). In Italy, it is especially important on protected crops of ornamentals and vegetables (Inserra & Calabretta, 1985; Nucifora, 1985). In Greece, *S. littoralis* causes slight damage in Crete on lucerne and *Trifolium* only.

Control

The chemical control of *S. littoralis* has been extensively reported in relation especially to cotton in Egypt, and of *S. litura* in relation to various crops in India. Until 1968, *S. littoralis* was held in check by methyl-parathion, but then resistance to this compound developed. Since then, numerous other organophosphorus, synthetic pyrethroid and other insecticides have been used, with appearance of resistance and cross resistance in many cases (Issa *et al.*, 1984a; 1984b; Abo-El-Ghar *et al.*, 1986). However, compulsory limitation of the application of synthetic pyrethroids to one per year on cotton in Egypt has stopped the appearance of new resistance (Sawicki, 1986). Chemicals used against *Spodoptera* spp. also include insect growth regulators. There is interest, especially in India,

in various antifeedant compounds or extracts, and in natural products such as azadirachtin and neem extract.

Numerous studies have been carried out on possible biological control of the two species. Parasites (braconids, encyrtids, tachinids, ichneumonids) and predators have been extensively documented. A nuclear polyhedrosis virus has been evaluated against *S. litura*, while fungi and microsporidia have also been recorded as parasites. Parasitic nematodes such as *Neoaplectana carpocapsae* have also been evaluated. However, direct use of these biocontrol agents has not apparently passed into practice. Treatment with *Bacillus thuringiensis* has been used (Navon *et al.*, 1983), but only some strains are effective since *S. littoralis* is resistant to many strains (Salama *et al.*, 1989).

Integrated pest management techniques, favouring beneficial arthropods, are applied especially against *S. littoralis* on cotton in Egypt. These involve hand collection of egg masses, use of microbial pesticides and insect growth regulators and slow-release pheromone formulations for mating disruption. If these measures are taken, relatively few applications of conventional insecticides are necessary (Campion & Nesbitt, 1982; Hosny *et al.*, 1983; Campion & Hosny, 1987). Damage thresholds have been established by Hosny *et al.* (1986). Pheromones have also been used for mass trapping by the lure and kill technique (McVeigh & Bettany, 1987) and for monitoring populations. Das & Roy (1985) review the use of pheromones against *S. litura*. Souka (1980) has experimented with irradiation for sterile-insect release, but this technique does not appear to have been applied.

Phytosanitary risk

EPPO has listed *S. litura* as an A1 (OEPP/EPPO, 1979), and *S. littoralis* as an A2 quarantine pest (OEPP/EPPO, 1981). CPPC, NAPPO and OIRSA also consider the two species of quarantine significance. *S. littoralis* is already fairly widespread in Mediterranean countries and does not present a phytosanitary risk there. Since *S. litura* is very similar and attacks essentially the same host plants, it is not obvious that it could establish in the presence of *S. littoralis* or present an additional risk. So the real phytosanitary risk for both species is their possible introduction into glasshouses in most parts of Europe, where they may damage many ornamental and vegetable crops. Although control with insecticides is possible, there have been many cases of resistance. In addition, there is no immediately available biological control method, which means that introduction of *Spodoptera* spp. could require insecticide treatments that might interfere with existing biological control of other pests.

PHYTOSANITARY MEASURES

For planting material, EPPO recommends (OEPP/EPPO, 1990) absence of the pests from the place of production during the last 3 months, or treatment of the consignment. For cut flowers, pre-export inspection is considered sufficient.

Cold storage of chrysanthemum and carnation cuttings for at least 10 days at a temperature not exceeding 1.7°C will kill all stages of *S. littoralis*, and presumably also *S. litura*, but may damage the plants. Storage at slightly higher temperatures or shorter durations does not eradicate *S. littoralis*, but differences in response to cold have been observed both between strains and within developmental stages of the pest (Powell & Gostick, 1971; Miller, 1976). The standard treatment now used in the UK is cold storage for 2-4 days at less than 1.7°C, followed by methyl bromide fumigation at 15-20°C with a CTP of 54 g h m^3 (Mortimer & Powell, 1988). This has been adopted as an EPPO quarantine procedure (OEPP/EPPO, 1984). Irradiation has been investigated as a treatment for cut flowers (Navon *et al.*, 1988). For cut chrysanthemum flowers, Wang & Lin (1984)

suggest enclosing buds in perforated polythene bags to exclude the pest and dipping the cut stems in insecticide solutions.

BIBLIOGRAPHY

Abo-El-Ghar, M.R.; Nassar, M.E.; Riskalla, M.R.; Abd-El-Ghafar, S.F. (1986) Rate of development of resistance and pattern of cross-resistance in fenvalerate and decamethrin-resistant strains of *Spodoptera littoralis*. *Agricultural Research Review* **61**, 141-145.

Aitkenhead, P.; Baker, C.R.B; Chickera, G.W.D. de (1974) An outbreak of *Spodoptera litura*, a new pest under glass in Britain. *Plant Pathology* **23**, 117-118.

Baker, C.R.B.; Miller, G.W. (1974) Some effects of temperature and larval food on the development of *Spodoptera littoralis*. *Bulletin of Entomological Research* **63**, 495-511.

Bishara, I. (1934) The cotton worm *Prodenia litura* F. in Egypt. *Bulletin de la Société Entomologique d'Egypte* **18**, 223-404.

Brown, E.S.; Dewhurst, C.F. (1975) The genus *Spodoptera* in Africa and the Near East. *Bulletin of Entomological Research* **65**, 221-262.

Campion, D.G.; Hosny, M.M. (1987) Biological, cultural and selective methods for control of cotton pests in Egypt. *Insect Science and its Application* **8**, 803-805.

Campion, D.G.; Nesbitt, F. (1982) Recent advances in the use of pheromones in developing countries with particular reference to mass-trapping for the control of the Egyptian cotton leafworm *Spodoptera littoralis* and mating disruption for the control of pink bollworm *Pectinophora gossypiella*. In: *Les médiateurs chimiques agissant sur le comportement des insectes*, pp. 335-342. INRA, Paris, France.

Cayrol, R.A. (1972) Famille des Noctuidae. In: *Entomologie appliquée à l'agriculture* (Ed. by Balachowsky, A.S.), vol. 2, pp. 1411-1423. Masson, Paris, France.

CIE (1967) *Distribution Maps of Pests, Series A* No. 232. CAB International, Wallingford, UK.

Cunningham, I.C.; Broadley, R.H. (1975) The major insect pests of tobacco. *Queensland Agricultural Journal* **101**, 617-622.

Das, B.K.; Roy, P. (1985) Sex pheromone of the tobacco caterpillar *Spodoptera litura* and its use in integrated pest management. *Journal of Bengal Natural History Society* **4**, 127-138.

Hachler, M. (1986) [Notes on three pests of subtropical ornamental plants captured in western Switzerland]. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* **59**, 263-266.

Holloway, J.D. (1989) The moths of Borneo: Family Noctuidae, trifine subfamilies: Noctuinae, Heliothinae, Hadeninae, Acronictinae, Amphipyrinae, Agaristinae. *Malayan Nature Journal* **42**, 57-226.

Hosny, M.M.; Saadany, G.; Iss-Hak, R.; Nasr, E.A.; Moawad, G., Naguib, M.; Khidr, A.A.; Elnagar, S.H.; Campion, D.G.; Critchley, B.R.; Jones, K.; McKinley, D.J.; McVeigh, L.J.;

Topper, C.P. (1983) Techniques for the control of cotton pests in Egypt to reduce the reliance on chemical pesticides. In: *Proceedings of the 10th International Congress of Plant Protection 1983*, p. 270. British Crop Protection Council, Croydon, UK.

Hosny, M.M.; Topper, C.P.; Moawad, G.M.; El-Saadany, G.B. (1986) Economic damage thresholds of *Spodoptera littoralis* on cotton in Egypt. *Crop Protection* **5**, 100-104.

IIE (1993) *Distribution Maps of Pests, Series A* No. 61 (2nd revision). CAB International, Wallingford, UK.

Inserra, S.; Calabretta, C. (1985) [Attack by noctuids: a recurring problem in greenhouse crops of the Ragusa coast]. *Tecnica Agricola* **37**, 283-297.

Issa, Y.H.; Keddis, M.E.; Abdel-Sattar, M.A.; Ayad, F.A.; El-Guindy, M.A. (1984a) Survey of resistance to organophosphorus insecticides in field strains of the cotton leafworm during 1980-1984 cotton-growing seasons. *Bulletin of the Entomological Society of Egypt, Economic Series* **14**, 399-404.

Issa, Y.H.; Keddis, M.E.; Abdel-Sattar, M.A.; Ayad, F.A.; El-Guindy, M.A. (1984b) Survey of resistance to pyrethroids in field strains of the cotton leafworm during 1980-1984 cotton-growing seasons. *Bulletin of the Entomological Society of Egypt, Economic Series* **14**, 405-411.

McVeigh, L.J.; Bettany, B.W. (1987) The development of lure and kill technique for control of the Egyptian cotton leafworm *Spodoptera littoralis*. *Bulletin SROP* **10**, 59-60.

Miller, G.W. (1976) Cold storage as a quarantine treatment to prevent the introduction of *Spodoptera littoralis* into glasshouses in the UK. *Plant Pathology* **25**, 193-196.

Miyahara, Y.; Wakikado, T.; Tanaka, A. (1971) [Seasonal changes in the number and size of the egg-masses of *Prodenia litura*]. *Japanese Journal of Applied Entomology and Zoology* **15**, 139-143.

Mochida, O. (1973) Two important pests, *Spodoptera litura* and *S. littoralis* on various crops morphological discrimination of the adult, pupal and larval stages. *Applied Entomology and Zoology* **8**, 205-214.

Mortimer, E.A.; Powell, D.F. (1988) Factors affecting the efficacy of methyl bromide fumigation to control *Liriomyza trifolii* in imported chrysanthemum cuttings. *Annals of Applied Biology* **112**, 33-39.

Nakasuji, F. (1976) Factors responsible for change in the pest status of the tobacco cutworm *Spodoptera litura*. *Physiology and Ecology Japan* **17**, 527-533.

Nakasuji, F.; Matsuzaki, T. (1977) The control threshold density of the tobacco cutworm *Spodoptera litura* on eggplants and sweet peppers in vinylhouse. *Applied Entomology and Zoology* **12**, 184-189.

Nasr, E.S. A. (1973) Effect of temperature and relative humidity on the life cycle of the cotton leafworm, *Spodoptera littoralis*. *Bulletin de la Société Entomologique d'Egypte* **57**, 139-144.

Navon, A.; Wysoki, M.; Keren, S. (1983) Potency and effect of *Bacillus thuringiensis* preparations against larvae of *Spodoptera littoralis* and *Boarmia* (*Ascotis*) *selenaria*. *Phytoparasitica* **11**, 3-11.

Navon, A.; Yatom, S.; Padova, R.; Ross, I. (1988) [Gamma irradiation of *Spodoptera littoralis* eggs and neonate larvae to eliminate the pest on flowers for export]. *Hassadeh* **68**, 722-724.

Nucifora, A. (1985) [Successive cultivation and systems of integrated control in protected crops of the Mediterranean area]. *Tecnica Agricola* **37**, 223-241.

OEPP/EPPO (1979) Data sheets on quarantine organisms No. 42, *Spodoptera litura*. *Bulletin OEPP/EPPO Bulletin* **9** (2).

OEPP/EPPO (1981) Data sheets on quarantine organisms No. 120, *Spodoptera littoralis*. *Bulletin OEPP/EPPO Bulletin* **11** (1).

OEPP/EPPO (1984) Quarantine procedures No. 16. Combined methyl bromide fumigation and cold storage treatment for chrysanthemum cuttings. *Bulletin OEPP/EPPO Bulletin* **14**, 596, 606.

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

Patel, H.K.; Patel, N.G.; Patel, V.C. (1971) Quantitative estimation of damage to tobacco caused by the leaf-eating caterpillar, *Prodenia litura*. *PANS* **17**, 202-205.

Powell, D.F.; Gostick, K.G. (1971) Control of *Spodoptera littoralis*, *Myzus persicae* and *Tetranychus urticae* by cold storage and fumigation. *Bulletin of Entomological Research* **61**, 235-240.

Rao, G.V.R.; Wightman, J.A.; Rao, D.V.R. (1989) Threshold temperatures and thermal requirements for the development of *Spodoptera litura*. *Environmental Entomology* **18**, 548-551.

Salama, H.S.; Dimetry, N.Z.; Salem, S.A. (1970) On the host preference and biology of the cotton leaf worm *Spodoptera littoralis*. *Zeitung für Angewandte Entomologie* **67**, 261-266.

Salama, H.S.; Foda, M.S.; Sharaby, A. (1989) A proposed new biological standard for bioassay of bacterial insecticides versus *Spodoptera* spp. *Tropical Pest Management* **35**, 326-330.

Salama, H.S.; Shoukry, A. (1972) Flight range of the moth of the cotton leaf worm *Spodoptera littoralis*. *Zeitung für Angewandte Entomologie* **71**, 181-184.

Sawicki, R.M. (1986) Resistance to synthetic pyrethroids can be countered successfully. *Agribusiness Worldwide* **8**, pp. 5, 20, 22-25.

Schmutterer, H. (1969) *Pests of crops in Northeast and Central Africa*, pp. 186-188. Gustav Fischer Verlag, Stuttgart, Germany.

Shutova, N.N.; Cheknonadskikh, V.A. (1974) [The cotton leafworm]. *Zashchita Rastenii* No. 4.

Souka, S. (1980) Effects of irradiation by sterilizing and substerilizing doses on parents and F1 of the cotton leafworm *Spodoptera littoralis*. *Bulletin de la Société Entomologique d'Egypte* **63**, 19-27.

Srivastava, O.S.; Malik, D.S.; Thakur, R.C. (1972) Estimation of losses in yield due to the attack of arthropod pests in soybean. *Indian Journal of Entomology* **33**, 224-225.

Wang, C.L.; Lin, R.T. (1984) [Study on the quarantine treatments of insect pests on chrysanthemum cut flowers application of protection bags and improved dipping methods]. *Journal of Agricultural Research of China* **33**, 325-330.