



## A CHECKLIST OF INSECT PESTS OF ONION

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### ABSTRACT

A checklist of onion insect pests is given herein with 149 species of eleven arthropod orders, viz., Coleoptera, Collembola, Dermaptera, Diptera, Orthoptera, Hemiptera, Hymenoptera, Thysanoptera and Lepidoptera and two of Acarina, such as Sarcoptiformes and Trombidiformes. This comprises 49 families of which 46 are insect and three of Acarina. Insect family, Noctuidae includes maximum genera (16), species (27) followed by the Aphididae (8), Agromyzidae (8), Thripidae (7), Anthomyiidae (6), Syrphidae, (6), Acarididae (6), Pyralidae (5), Scarabaeidae (5), Tetranychidae (4), Muscidae (4), Fanniidae (4), Nitidulidae (3), Onychiuridae (3), Eriophyidae (2), and Simunthridae (1) are others observed. Diversity analysis revealed that foliage feeders are the dominant (69.1%) comprising of sucking pests (aphids and thrips), defoliators (cutworms and leaf eating caterpillars) and leaf miners. Bulb feeders account about 18.8% (flies, beetles, weevils, moths and mites), and root feeders represent 8.7%.

**Key words:** *Allium* sp., pests, insects, mites, foliage, feeders, sucking pest, defoliators, bulb feeders, root feeders, families, genera, species

Onion is one of the important bulb vegetables grown in India and other parts of the world. India ranks first in cultivation area and second in production (Kumar et al., 2015) and is cultivated about 1.3 million hectares area with the annual production of 22.40 mt (FAOSTAT, 2017). Onion is attacked by number of insect pests including thrips, maggots, cut worms, leaf miner, aphids, beetles, earwigs and mites at different stages of crop growth, including seedling, bulbing and blooming. In addition to direct damage, insect pest such as thrips *Thrips tabaci* Lindeman and aphids *Myzus persicae* (Sulzer) and *Aphis craccivora* C.L Koch acts as vector for deadly viral diseases such as iris yellow spot (Pozzer et al., 1999) and onion yellow dwarf virus (Mahmoud et al., 2008). Furthermore, some insect pests also injurious to harvested bulbs at storage which reduce the quality and export potential of the produce. Being a major consuming, exporting as well as importing commodity to fulfill the domestic requirement, knowledge and information of insect pests is vital for pest management planning. Hence, an updated list of insect pests attacking onion at field as well as storage is necessary for devising preventive and effective IPM strategies. Therefore, in this report, a detailed list of onion insect pests is presented.

### Checklist

The present compilation provides an up-to date comprehensive checklist of onion pests with literature compiled and condensed in the form of a checklist. Insect

pests were grouped according to their taxonomic level as well as their feed habits. The insect feeding stage, parts fed, distribution and corresponding references have been compiled and included. A total of 149 pests, including eight insects and two acarines, 49 arthropod families and 97 insect genera are known worldwide (Table 1). Order and family wise and genera and species are provided. Among these, a maximum number of species fall under Noctuidae (16 genera and 27 species), followed by mites, Aphididae, Agromyzidae, Anthomyiidae and Syrphidae, Muscidae and Thripidae and Elateridae, and Acrididae and Scarabaeidae (Fig. 1). Others with one or few genus and species are Chrysomelidae, Curculionidae, Anobiidae, Meloidae, Furculidae, Ephydriidae, Heliomyzidae, Sciaridae, Ulidiidae, Aleyrodidae, Delphacidae, Pentatomidae, Geometridae, Pieridae, Tineidae, Sminthuridae, and Gryllotalpidae. Literature revealed that foliage eating insects (stem / pseudo stem / leaf) was dominant (69.1%) followed by bulb feeders (18.8%), root feeders (8.7%), umbel / flower feeders (2.7%) and seed feeders (0.7%) (Fig. 2). Onion thrips, *Thrips tabaci* Lindeman and western flower thrips, *Frankliniella occidentalis* (Pergande) are major sucking pests causing economic damage worldwide. Thrips act as vector for deadly Irish Yellow Spot Virus in both the onion seed crop and the bulb crop. Beside aphids *Myzus* sp and Neotoxoptera sp were dominant sucking pests of onion. Onion maggot, *Delia antiqua* is a major dipteran pest of onion, particularly in the cooler regions. Cutworm *Spodoptera*

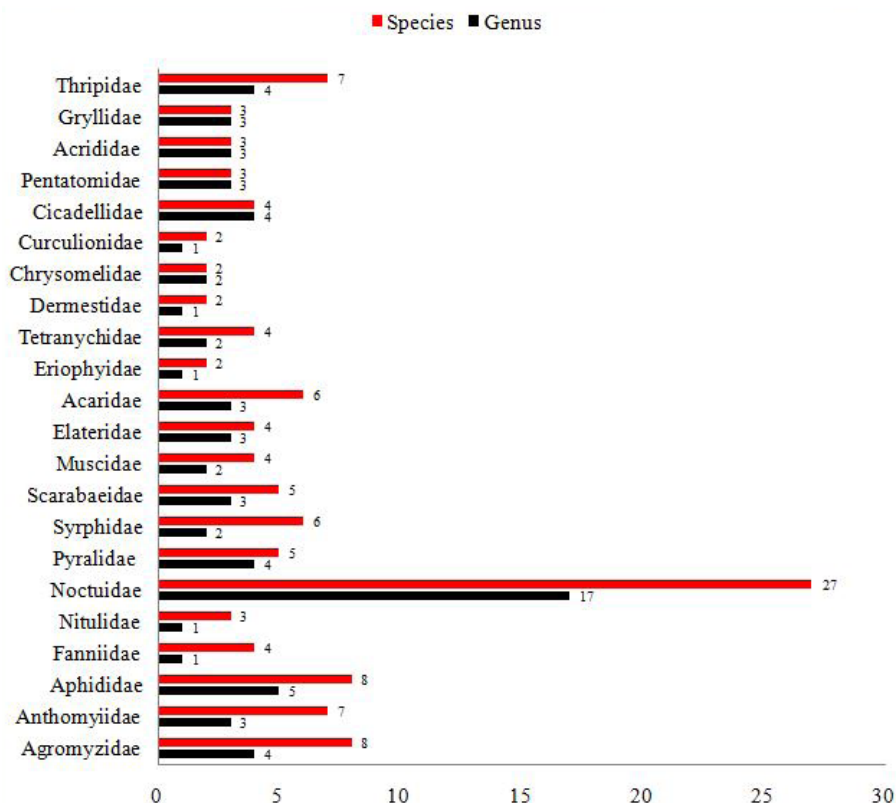


Fig.1. Major insect families associated with onion

sp, *Euxoa* sp, *Peridroma* sp and *Agrotis* sp are also predominant lepidopterans infesting onion. Dried fruit beetle *Carpophilus* sp., cigarette beetle, *Lasioderma serricorne* (F.), warehouse moths, *Plodia interpunctella* (Hubner), *Ephestia cautella* (Walker) and bulb mite, *Rhizoglyphus* sp are important pests at storage causing economic damage. Apterygote insects, Collembola, springtails, *Onychiurus* sp. have been also documented as root feeders in onion.

Kaundal (2018) had earlier provided a global and Indian scenario of insect pests infesting onions. He listed 77 insect and seven mite species from 10 orders and 31 families are known worldwide. Of these, Lepidopterans are the most abundant, followed by dipterans, hemipterans and coleopterans. Pests

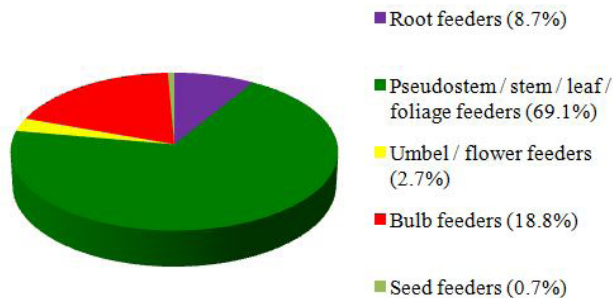


Fig. 2. Functional diversity of insect pests of onion

including onion thrips *Thrips tabaci* Lindeman, onion maggot *Delia anitqua* (Meign), beet army worm, *Spodoptera exigua* Hubner, head borer *Helicoverpa armigera* (Hubner), golden wing moth *Trichoplusia orichalcea* F., cut worm *Agrotis* sp., bulb mite *Rhizoglyphus robini* (Claparede), and red spider mite, *Tetranychus cinnabarinus* (Boisduval) are the major pests. In India, 25 insect and four mite species from eight orders and 13 families have been documented, with ten of them classified as pests (Kaundal, 2018; Kaundal and Sood., 2021). *Altica* sp., *Chromatomyia horticola* (Goureau), *Euconocephalus* sp., *Gryllus* sp., *H. armigera* (Hubner), *Melolontha furicicauda* Ancy, *Nezara viridula* L., *Spodoptera litura* (F.), *T. tabaci* and *T. orichalcea* are some pests; *T. tabaci* is the major pest, followed by *D. antiqua*, whereas, *H. armigera*, *A. ipsilon*, and *S. litura* are minor pests (Gupta et al., 1991). Bulb fly, *Atherigona orientalis* and dried fruit beetle *Carpophilus obsoletus* Erichson have been found in stored onion bulbs. *D. antiqua* is a problem in cold arid Ladak region of India (Gupta et al., 2019); *T. tabaci*, *D. antiqua*, *R. robini*, eriophyid mite *Aceria tulipae* Keifer and *T. cinnabarinus* are pests of national significance; while *H. armigera*, *A. ipsilon*, and *S. litura* are pests of regional significance (Satyagopal et al., 2014). In addition, the beet army

worm, *S. exigua*, the green looper, *Chrysodeixis acuta* Walker, *Liriomyza huidobrensis* (Blanchard), *L. sativa* Blanchard damaging onion green foliage and *Lasioderma serricorne* (F.) onion seeds are also known (Karuppaiah et al., 2019; Soumia et al., 2020; Verma et al., 2011).

## REFERENCES

- Abo El-Ghar M R, Osman A A. 1973. Ecological and control studies on mites associated with onion in Egypt. *Zeitschrift Fur Angewandte Entomologie* 73: 439-442.
- Abo El-Ghar M R, Osman A A. 2009. Ecological and control studies on mites associated with onion in Egypt. *Journal of Applied Entomology* 73: 439-442.
- Abu-Hashish T A. 1998. Monthly population density and laboratory rearing of *Carpophilus hemipterus* (L.) (Coleoptera: Nitidulidae) on onion prepared for exportation and dehydration. *Annals of Agricultural Science Moshtohor* 36: 1969-980.
- Ahmad B, Khan W, Ahmad-Ur-Rahman S, Sattar S, Zada H, Maula F, Hussain S. 2019. Management of onion seed worm (*Helicoverpa armigera*) associated with onion seed crop in Swat valley of Khyber Pakhtunkhwa. *Pure and Applied Biology* 8: 68-77.
- Andersen A, Nordhus E, Thang V T, An T T T, Hung H. Q, Hofsvang T. 2002. *Polyphagous Liriomyza* species (Diptera: Agromyzidae) in vegetables in Vietnam. *Tropical Agriculture (Trinidad)* 79: 241-246.
- Andersen A, Tran T T A, Nordhus E. 2008. Distribution and importance of polyphagous *Liriomyza* species (Diptera, Agromyzidae) in vegetables in Vietnam. *Norwegian Journal of Entomology* 55: 149-164.
- Arida G S, Punzal B S, Ravina C C, Gapud V P, Rajotte E G, Talekar N S. 2004. Monitoring adult populations of two insect pests with sex pheromone traps for effective timing of interventions against the defoliators of onion (*Allium cepa* L.) grown after rice (*Oryza sativa* L.). *The Philippine Entomologist* 18: 139-150.
- Arida G S, Punzal, B S, Shepard B M, Edwin, G R. 2013. Sticky board traps for managing leaf miner, *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) infestations in onion (*Allium cepa* Linn.). *Philippine Entomologist* 27: 109-119.
- Arimoto M, Uesugi R, Hinomoto N, Sueyoshi M, Yoshimatsu S. 2018. Molecular marker to identify the fungus gnat, *Bradysia* sp. (Diptera: Sciaridae), a new pest of Welsh onion and carrot in Japan. *Applied Entomology and Zoology* 53: 419-424.
- Arulkumar G, Manisegaran S, Nalini R, Mathialagan M. 2017. Seasonable abundance of beet armyworm *Spodoptera exigua* (Hubner) infesting Onion with weather factors in Madurai district of Tamil Nadu. *Journal of Entomology and Zoology Studies* 5: 1157-1162.
- Awadalla S S, Naggar M E, Abdel B N F, Hamid O F. 2011. The insect pests attacking onion plants with special references to the onion thrips *Thrips Tabaci* Lindeman at Mansoura Region. *Journal of Plant Protection and Pathology* 2: 1-12.
- Awadalla S S, Taman A A, Aboria A A. 2017. Influence of the different onion varieties on the population density of the main insect pests infesting onion crop in Kafr ElShekh region. *Journal of Plant Protection and Pathology Mansoura University* 8: 403-406.
- Bankowska R. 1980. Fly communities of the family Syrphidae in natural and anthropophilic habitats of Poland. *Memorabilia Zoologica* 33: 1-94.
- Barbagallo S, Ciampolini M. 2000. The onion aphid, *Neotoxoptera formosana* Takahashi, detected in Italy Rinvenimento in Italia dellafide della cipolla *Neotoxoptera formosana* Takahashi. *Bollettino di Zoologia Agraria ed Bachicoltura* 323: 245-258.
- Barringer L E, Fleischer S J, Roberts D, Spichiger S E, Elkner T. 2018. The first North American record of the *Allium* leafminer. *Journal of Integrated Pest Management* 9: 8.
- Bechinski E J, Smith L J, Merickel F W. 2009. Large yellow underwing, a new cutworm in Idaho. CIS 1172. College of Agriculture and Life Sciences. University of Idaho Extension, Moscow.
- Braithwaite C W D. 1983. Pest and Diseases of Onion. Proceedings. Onion production and research for the eighties workshop, Barbados, 1983. pp. 56-76.
- Broadbent B M. 1925. Notes on the life history of the lesser bulb fly *Eumerus strigatus* fallen. *Journal of Economic Entomology* 18: 141-143.
- Capinera J L. 2001. Handbook of vegetable pests. Academic Press, San Diego. p.729.
- Carolina J H, Johnson M W. 1992. Host plant preference of *Liriomyza sativae* (Diptera: Agromyzidae) populations infesting green onion in Hawaii. *Environmental Entomology* 21: 1097-1102.
- Carter D J. 1984. Pest Lepidoptera of Europe: With special reference to the British Isles. D R W Junk Publisher Lancaster, England.
- Carvalho J B, de Courim S, Ponta C, Pamplona D, Lopes S M. 2005. A catalogue of the Muscidae (Diptera) of the neotropical region. *Zootaxa* 860: 282.
- Chandel R S, Mehta P K, Sharma P C, Pathania M. 2016. Insect-pests of onion and garlic. *Insect pests of vegetable crops*. Kalyani Publishers, Ludhiana. 223-230 pp.
- Chaudhary R N, Kanaujia K R, Sharma V K. 1987. A note on the incidence of seed corn maggot, *Delia platura* Meigen (Anthomyiidae: Diptera) in spring sown maize. *Bulletin of Entomology (New Delhi)* 28: 159-161.
- Chen W H, Liu Y C, Ho C C, Chang T Y. 2002. A newly recorded mite pest, *Rhizoglyphus setosus* Manson (Acari: Acaridae) of onion in Taiwan. *Plant Protection Bulletin (Taipei)* 44: 249-253.
- Chen X, Fa-yong L, Zhi-hong X U, Jun-hua H E and Yun M A. 2003. The occurrence of leafminers and their parasitoids on vegetables and weeds in Hangzhou area, Southeast China. *Bio Control* 48: 515-527.
- Chittenden F H. 1913. Insects injurious to the onion crop. Year book. Department of Agriculture. pp. 319-334.
- Cho J R, Boo K S. 1988. Behavior and circadian rhythm of emergence, copulation and oviposition in the oriental tobacco budworm, *Heliothis assulta* Guenée. *Korean Journal of Applied Entomology* 27: 103-110.
- CIE 1985. *Delia platura* (Meigen) (Diptera: Anthomyiidae) bean seed fly, seed corn maggot. Distribution maps of pests, series A. Wallingford, CAB International, UK.
- Collin J E. 1920. *Eumerus strigatus* Fallen and *tuberculatus*, Rondani (Diptera: Syrphidae). *Entomologist's Monthly Magazine* 1: 102-106.
- Collins D W, Lole M. 2005. *Phytomyza gymnostoma* Loew (Diptera: Agromyzidae), a leaf mining pest of leek and onion new to Britain. *The Entomologist's Monthly Magazine* 141: 131-137.
- Coman M, Rosca I. 2011. Biology and life cycle of leafminer *Napomyza* (*Phytomyza*) *gymnostoma* Loew, a new pest of *Allium* plants in Romania. *South West Journal of Horticulture, Biology and Environment* 2: 57-64.
- Conijn C G M, Van Aartrijk J, Leśna I. 1996. Flower bulbs. In *Eriophyoid mites: Their biology, natural enemies and control* edited by

- Lindquist E E, Sabelis M W, Bruin J. World Crop Pests. Amsterdam, Elsevier Science Publishing. pp. 651-659.
- Cork K, Boo S, Dunkelblum E, Hall D R, Jee-Rajunga K, Kehat M, Kong Jie E, Park K C, Tepgidagarn P, Xun L. 1992. Female sex pheromone of oriental tobacco budworm, *Helicoverpa assulta* (Guenée) (Lepidoptera: Noctuidae): identification and field testing. *Journal of Chemical Ecology* 18: 403-418.
- Coudriet D L, Kishaba A N, McCreight J D, Bohn G W. 1979. Varietal resistance in onions to thrips. *Journal of Economic Entomology* 72: 614-615.
- Coviello R L, McGriffen M E. 1995. Damage threshold for thrips on drying onions. University of California. *Plant Protection Quarterly* 5: 2-4.
- Debnath P, Karmakar K. 2013. Garlic mite, *Aceria tulipae* (Keifer) (Acari: Eriophyoidea)-a threat for garlic in West Bengal, India. *International Journal of Acarology* 39: 89-96.
- Diaz A, Okabe K, Eckenrode C J, Villani M G, Oconnor, B M. 2000. Biology, ecology, and management of the bulb mites of the genus *Rhizoglyphus* (Acari: Acaridae). *Experimental and Applied Acarology* 24: 85-113.
- Diaz-Montano J, Fuchs M, Nault B A, Fail J, Shelton A M. 2010. Onion thrips (Thysanoptera: Thripidae): a global pest of increasing concern in onion. *Journal of Economic Entomology* 104: 1-13.
- Dimetry N Z, Shoukry A, Aboul-Zahab A. 1978. On the biology of the cigarette beetle *Lasioderma serricorne* (Fabricius) attacking dehydrated onion in Egypt. Proceedings fourth conference of pest control, 1978. p.132.
- Doane J F. 1983. Attraction of the lesser bulb fly *Eumerus strigatus* (Diptera: Syrphidae) to decomposing oatmeal. *New Zealand Entomologist* 7: 419.
- EFSA Panel on Plant Health. 2015. Scientific Opinion on the pest categorization of *Spodoptera littoralis*. *EFSA Journal* 13: 3987.
- Elbolok M M, Ismail I I, Elshabrawi H A. 1990. Survey and relative abundance of insects attacking onion in field and storage with accompanied natural enemies at Giza and Assuit region. *Annals of Agricultural Sciences, Moshtohor* 28: 1791-1804.
- Ellis S A, Scatcherd J E. 2007. Bean seed fly (*Delia platura*, *Delia florilega*) and onion fly (*Delia antiqua*) incidence in England and an evaluation of chemical and biological control options. *Annals of Applied Biology* 151: 259-267.
- El-Sherif S I, Mahmoud H H. 2008. The population densities of two major insect pests of onion, the onion thrips (*Thrips tabaci* Lind.) in fields and the onion bulb fly (*Eumerus amoenus* Loew.) in stores. *Bulletin of Faculty of Agriculture Cairo University* 59: 326-332.
- Esbjerg P, Ravn H P, Percy-Smith A. 1995. Budworm in ecological vegetables. *Gron Viden, Havebrug* 87: 6.
- FAO 2017. www. faostat. fao.org. Accessed in October 2019.
- Gill H K, Garg H, Gill A K, Gillett-Kaufman J L, Nault B A. 2015. Onion thrips (Thysanoptera: Thripidae) Biology, Ecology, and Management in Onion Production Systems. *Journal of Integrated Pest Management* 6: <https://doi.org/10.1093/jipm/pmv006>.
- Greco N M, Pereyra P C, Guillade A. 2006. Host-plant acceptance and performance of *Tetranychus urticae* (Acari: Tetranychidae). *Journal of Applied Entomology* 130: 32-36.
- Griffiths G C D. 1993. Cyclorrhapha II (Schizophora: Calypratae). Part 2, Anthomyiidae. *Inflies of the Nearctic region* edited by Griffiths G C D. Stuttgart, Germany. Schweizerbart'sche Verlagsbuchhandlung 8:1417-1632.
- Gupta R P, Bharadwaj B S, Pandey U B. 1985. The leaf miner, *Chromatomyia horticola* (Goureau) assumes status of a pest of onion in India. *Journal of Entomological Research* 91: 111-112.
- Gupta R P, Srivastava K J, Pandey U B. 1991. Management of onion diseases and insect pests in India. *Onion Newsletter for the Tropics*. No. 3:15-17.
- Gupta S, Rana N, Chandravanshi H. 2016. Effect of population of onion, *Allium cepa* L. insect pests in relation to biotic factors under field condition. *Natural resource management: Ecological perspective*. Proceedings. Indian ecological society international conference, Sher e-Kashmir University of Agricultural Sciences and Technology, Jammu. 299 pp.
- Gupta V, Namgyal D, Kumar A, Namgyal D, Angchuk S, Safal R. 2019. Assessment of integrated pest management against onion maggot in Trans Himalaya Leh. *International Journal of Current Microbiology and Applied Sciences* 8: 2180-2183.
- Hai Fan Q, Zhang Z. 2003. *Rhizoglyphus echinopus* and *Rhizoglyphus robini* (Acari: Acaridae) from Australia and New Zealand: identification, host plants and geographical distribution. *Systematic and Applied Acarology* 16: 1-16.
- Haile B, Tsegaye B, Hailu A. 2016. Diseases and insect pests of onion (*Allium cepa* L.) in Masha district of Sheka Zone, South-West Ethiopia. *Academia Journal of Agricultural Research* 4(10): 629-632.
- Hall K D, Holloway R L, Smith D T. 2011. Texas crop profile onion. <http://liveoak.agrilife.org/files/2011/07/TexasCropProfileOnions5.pdf> Accessed 4 August 2021.
- Hamilton J T, Toffolon R B. 1986. Seedling maggots. *Agfacts*, No. 44.
- Harmatha J, Mauchamp B, Arnault C, Slama K. 1987. Identification of a spirostane-type saponin in the flowers of leek with inhibitory effects on growth of leek-moth larvae. *Biochemical Systematics and Ecology* 15: 113-116.
- Haydar M F, El-Sherif L S. 1987. Ecological aspects and developing method of onion pest control. *Bulletin of Entomological Society of Egypt* 16: 119-126.
- Hennig W, 1974. Anthomyiidae. Die fliegen der Palaearktischen region, 7 Lindner E (ed.). Stuttgart, Germany. Schweizerbart'sche Verlagsbuchhandlung, pp.687-927.
- Heppner J B, 1998. *Spodoptera* armyworms in Florida (Lepidoptera: Noctuidae). Florida Department of Agriculture and Consumer Services, Division of Plant Industry Entomological Circular 390. p.5.
- Hesler L S. 1995. Bibliography on *Hydrellia griseola* Fallén (Diptera: Ephydriidae) and review of its biology and pest status. *Insecta Mundi* 9: 25-35.
- Hill D S. 1983. *Agricultural insect pests of the tropics and their control*. 2nd edition, Cambridge University Press, UK. 659 pp.
- Ho C. 2008. Bulb Mites, *Rhizoglyphus* (Acari: Acaridae). *Encyclopedia of entomology*. Capinera J L (ed), Springer, Dordrecht.
- Hodson W E H. 1927. The bionomics of the lesser bulb flies *Eumerus strigatus* fallen and *Eumerus tuberculatus* Rond, in south-West England. *Bulletin of Entomological Research* 17: 373-384.
- Hodson W. 1932. A comparison of the Larva of *Eumerus strigatus* Fln and *Eumerus tuberculatus* Rond. (Syrphidae). *Bulletin of Entomological Research* 23: 247-249.
- Hori M. 2007. Onion aphid (*Neotoxoptera formosana*) attractants, in the headspace of *Allium fistulosum* and *A. tuberosum* leaves. *Journal of Applied Entomology* 131: 8-12.
- Hurej M, Kucharczyk H, Twardowski J P. 2017. Thrips (Thysanoptera) associated with two genetically modified types of linseed (*Linum*

- usitatissimum* L.). Journal of Plant Disease and Protection 124: 81-91.
- Hwang C Y, Moon H C. 1995. Effect of temperatures on the development and fecundity of *Liriomyza chinensis* (Diptera: Agromyzidae). Korean Journal of Applied Entomology 34: 65-69.
- Ibrahim M M, Koura A, El-Halfaway M. 1970. Ecological and biological studies in some insects infesting dried onions. U.A.R. Agriculture Research Review 48: 59-63.
- Idinger J. 1995. Schlupfrichterfänge von Dipteren und parasitoiden Hymenopteren in unterschiedlich gedüngten Getreidefeldern. Mitteilungen der Deutschen Gesellschaft für Allgemeine und Angewandte Entomologie 10: 553-556.
- Iinuma A, Saito O. 1988. Additional notes on damages of onion by the onion stem borer, *Hydraecia mongoliensis* Urbahn, and their control. p. 232.
- Ireson J E. 1990. Studies on lucerne flea, *Sminthurus viridis* (L.) (Collembola: Sminthuridae) and other Collembola in the Tasmanian culture steppe. Ph.D. thesis, University of Tasmania.
- Ireson J E. 1993. Activity and pest status of surface-active Collembola in Tasmanian field crops and pastures. Journal of the Australian Entomological Society 32: 155-167.
- Isaev S I. 1931. Insects injurious to onions in the Rostov District. Bull. Instit. Controlling Pests Diseases 1: 25-53.
- Ja HyunNa, Rayoo M. 2000. The influence of temperature on development of *Plodia interpunctella* (Lepidoptera: Pyralidae) on dried vegetable commodities. Journal of Stored Product Research 36: 125-129.
- Jerzy S, Robert W. 2009. Phytophagous entomofauna occurring in onion plantation in Poland in years 1919-2007. Vegetable Crop Research Bulletin, Skerminiewice, Poland. pp. 5-14.
- Kang E J, Kang M G, Seo M J, Park S N, Kim C U, Yu M, Youn Y N. 2008. Toxicological effects of some insecticides against Welsh onion beet worm, *Spodoptera exigua*. Korean Journal of Applied Entomology 47: 155-162.
- Karuppaiah V, Soumia P S, Shinde P S, Singh M. 2019. Occurrence of green semilooper, *Chrysodeixis acuta* Walker in onion (*Allium cepa* L.) (Amaryllidaceae). Florida Entomologist 102: 783.
- Kaundal P, Sood A K. 2021. Diversity of insect fauna of onion in low and mid-hill regions of Himachal Pradesh. Indian Journal of Entomology 83: DoI No.: 10.5958/0974-8172.2020.00228.X.
- Kaundal P. 2018. Insect pests complex of onion in Himachal Pradesh. MSc Thesis, Chaudhary Sarwan Kumar Himachal Pradesh Viswa Vidyalaya, Palampur, HP.
- Kendall D M, Capinera J L. 1990. Geographic and temporal variation in the sex ratio of onion thrips. South-West Entomologist 15: 80-88.
- Kiedrowicz A, Brian G, Rector, Suzanne L, Lechoslaw K, Wiktorja S, Skoracka A. 2017. Population growth rate of dry bulb mite, *Aceria tulipae* (Acariformes: Eriophyidae), on agriculturally important plants and implications for its taxonomic status. Experimental and Applied Acarology 73: 1-10.
- Kirk W D J, Terry I. 2003. The spread of the western flower thrips *Frankliniella occidentalis* (Pergande). Agricultural and Forest Entomology 5: 301-310.
- Kumar A, Kosta V K, Nirmal A, Taram S K. 2017. Seasonal incidence of major insect pests of onion in relation to biotic and abiotic factors. Bulletin of Environment Pharmacology and Life Sciences 6: 201: 205.
- Kumar V, Neeraj S S, Sagar, N A. 2015. Post-harvest management of fungal diseases in onion- a review. International Journal of Current Microbiology and Applied Sciences 4: 737-752.
- Kuwahara M. 1988. Resistance of the bulb mite, *Rhizoglyphus robini* Claparede, to organophosphorus insecticides. Japan Agricultural Research Quarterly 22: 96-100.
- Lall B S, Singh L M. 1968. Biology and control of the onion thrips in India. Journal of Economic Entomology 61: 676-679.
- Luczak I. 1994. Threat of onion beetle *Lilioceris merdigera* L. (Coleoptera: Chrysomelidae) to onion grown from seed and sets in southern Poland. Polish Agricultural Annual. Series E-Plant Protection 23: 61-66.
- MacIntyre-Allen J K, Scott-Dupree C D, Tolman J H, Harris C R. 2005. Resistance of *Thrips tabaci* to pyrethroid and organophosphorus insecticides in Ontario, Canada. Pest Management Science 61: 809-815.
- Mahmoud H H. 2008. Ecological studies on certain insect pests of onion with special emphasis on the onion bulb fly *Eumerus amoenus* Loew. (Diptera: Syrphidae). Ph D Thesis, Faculty of Agriculture Cairo University Egypt.
- Mahmoud S Y M, Abo-El Maaty S A, Ali M E, Mahmoud H A. 2008. Identification of onion yellow dwarf virus potyvirus as one of the major virus infecting garlic in Egypt. International Journal of Virology 4: 1-13.
- Manson D C M. 1972. A contribution to the study of the genus *Rhizoglyphus* Claparede, 1869 (Acarina: Acaridae). Acarologia 13: 621-650.
- Mantel W P, Van de Vrie M. 1988. De Californische thrips, *Frankliniella occidentalis*, een nieuwe schadelijke tripssoort in de tuinbouw onder glas in Nederland. Entomologische Berichten 48: 140-144.
- Mantel W P, van de Vrie M. 1988. De Californische thrips, *Frankliniella occidentalis*, een nieuwe schadelijke tripssoort in de tuinbouw onder glas in Nederland. Entomologische Berichten 48: 140-144.
- Martin N A. 2004. History of an invader, *Scaptomyza flava* (Fallen, 1823) (Diptera: Drosophilidae), New Zealand Journal of Zoology 31: 27-32.
- Martin N, Workman P J, Hedderly D. 2006. Monitoring onion crops for onion thrips, *Thrips tabaci*. New Zealand Plant Protection 59: 69-74.
- Mason P, Weiss R, Olfert O, Appleby M, Landry J. 2011. Actual and potential distribution of *Acrolepiopsis assectella* (Lepidoptera: Acrolepiidae), an invasive alien pest of *Allium* spp. in Canada. The Canadian Entomologist 143: 185-196.
- Merrill L G, Hutson J R. 1953. Maggots attacking Michigan onions. Journal of Economic Entomology 46: 678-680.
- Merrill L G. 1951. Diptera reared from Michigan onions growing from seed. Journal of Economic Entomology 44: 1015.
- Mesic A, Baric J I, 2004. Diptera pests on onion vegetables in Croatia. Entomologia Croatica. Hrvatsko Entomolosko Drustvo, Zagreb, Croatia 8: 45-56.
- Mills H B. 1930. Springtails as economic insects. In proceedings of the Iowa Academy of Science 37: 389-392.
- Molet T. 2013. CPHST Pest datasheet for *Cryptoblabes gnidiella*. USDA-APHIS-PPQCPHST.
- Mujica N, Kroschel J. 2011. Leaf miner fly (Diptera: Agromyzidae) occurrence, distribution, and parasitoid associations in field and vegetable crops along the Peruvian coast. Environmental Entomology 40: 217-230.
- Munro. 2007. Best practices for integrated pest management in New Zealand. *Allium* crops. Onions NZ Inc. 94 pp.

- Murai T, Toda S. 2002. Variation of *Thrips tabaci* in colour and size. R Marullo, LA Mound (eds.), Thrips and tospoviruses: Proceedings. 7th International symposium on Thysanoptera. Australian National Insect Collection, Canberra, Australia. pp. 377-378.
- Nakao S, Chikamori C, Okajima S, Narai Y, Murai T. 2011. A new record of the tobacco thrips *Frankliniella fusca* (Hinds) (Thysanoptera: Thripidae) from Japan. Applied Entomology and Zoology 46: 131-134.
- Navia D, Graciela T, de Mendonca R S, Sagadin M. 2006. *Aceria tosichella* Keifer (Acari: Eriophyiidae) from wheat streak mosaic virus-infected wheat plants in Argentina. International Journal of Acarology 32: 189-193.
- Navia D, Ochoa R, Welbourn C, Ferragut F. 2010. Adventive eriophyoid mites: a global review of their impact, pathways, prevention and challenges. Experimental and Applied Acarology 51: 225-255.
- Olmstead D L, Shelton A M. 2012. Evaluation of insecticide chemistries against the leek moth (Lepidoptera: Acrolepiidae), a new pest in North America. Florida Entomologist 95: 1127-1131.
- Osmolowski G. 1980. Klucz do oznaczania szkodników na podstawie uszkodzeń roślin uprawnych. PWRiL, Warszawa. 755 pp.
- Ostovan H, Kamali K. 1995. New records of six species of astigmatic mites (Acari: Astigmata) infesting stored products in Iran. Journal of Agricultural Sciences- Islamic Azad University 1: 53-66.
- Park H H. 2015. Injury characteristics of *Allium* leaf miner, *Acrolepiopsis sapporensis* (Lepidoptera: Acrolepiidae) in Welsh onion and damage assessment according to larval density levels during summer. FAO, AGRIS 51: 383-388.
- Park J D, Goh H G. 1992. Control of the beet armyworm, *Spodoptera exigua* Hübner (Lepidoptera: Noctuidae), using synthetic sex pheromone I. Control by mass trapping in *Allium fistulosum* field. Korean Journal of Applied Entomology 31: 45-49.
- Passlow T. 1957. Control of *Thrips tabaci* Lind in onion crops in the Lockyer valley. Queensland Journal of Agricultural and Animal Sciences 14: 53-72.
- Piron P G M. 2010. Appearance of *Neotoxoptera formosana* (Homoptera: Aphididae) in the Netherlands. Entomologische Berichten 70: 10-12.
- Pobożniak M, Lesniak M, Chuda A, Adamus A. 2016. Field assessment of the susceptibility of onion cultivars to thrips attack-preliminary results. Polish Journal of Entomology 85: 121-133.
- Pont A C, Ackland D M. 1980. Family Anthomyiidae. Catalogue of the Diptera of the Afrotropical region. British Museum (Natural History), London, UK. pp. 715-718.
- Pont A C. 1974. A catalogue of the Diptera of the Americas south of the United States. Family Anthomyiidae. A catalogue of the Diptera of the Americas south of the United States. Family Anthomyiidae. Sao Paulo, Museu de Zoologia, Universidade de Sao Paulo, Brazil. pp. 21.
- Pozzer L, Bezerra I C, Kormelink R, Prins M, Peters D, Resende R de O, de Avila A C. 1999. Characterization of a tospovirus isolate of Iris yellow spot virus associated with a disease in onion fields in Brazil. Plant Disease 83: 345-350.
- Prasad N V V D, Sirisha K. 2009. Evaluation of insecticides and bio-pesticides for the management of *Spodoptera litura* in onion. Pestology 33: 45-48.
- Rabinowitch H D, Brewster J L. 1990. Onions and allied crops. Volume II: Agronomy biotic interactions. CRC Press, Broken Sound Parkway, NW. 332 pp.
- Rai S, Jotwani M G, Gupta R P. 1979. Occurrence of *Helicoverpa armigera* (Hubner) as a serious pest of onion (*Allium cepa* Linn.). Bulletin of Entomology (India) 20: 109-110.
- Rao S D V. 1998. Bio-ecology and management of ragi cutworm, *Spodoptera exigua* (Hübner) on onion. Ph D thesis. Acharya N. G. Ranga Agricultural University, Hyderabad, India.
- Reitz S R, Gao Y L, Lei Z R. 2011. Thrips: pests of concern to China and the United States. Agricultural Sciences in China 10: 867-892.
- Ronald F L M, Jayma L M K. 2007. *Liriomyza trifolii* (Burgess). Department of Entomology. Honolulu, Hawaii. [http://www.extento.hawaii.edu/kbase/crop/Type/liriomyz\\_t.htm](http://www.extento.hawaii.edu/kbase/crop/Type/liriomyz_t.htm). Accessed 4 August 2021.
- Rozkosny R. 1997. Anthomyiidae. In check list of Diptera (Insecta) of the Czech and Slovak Republics. Chvala M (ed.) Prague, Czech Republic, Karolinum, Charles University Press. pp. 90-92.
- Rubiya R, Murugan M, Shanthi M, Krishnamoorthi V, Vellaikumar S. 2019. Comparative feeding and digestive performance of four lepidopteran species of Larva on onion, *Allium cepa* var *aggregatum* L. as a host plant. International Journal of Current Microbiology and Applied Sciences 8: 1692-1702.
- Ruszkowska I. 1952. Observations of the biology of *Ceuthorrhynchus suturalis* Fabr. (Col.: Curculionidae). Annals University of Maria Skłodowska-Curie University, Lublin 14: 417-471.
- Sabra I M, Saleh H A, El Sappagh I A. 2011. Further studies on the main onion insect pests in store and their effect on yield loss in Fayoum, Governorate. Egyptian Journal of Agriculture Research 89: 1277-1285.
- Saito O. 1984. Life history of the onion stem borer, *Hydraecia mongoliensis* Urbahn in Hokkaido. Annual Report of the Society of Plant Protection of North Japan 35: 136-137.
- Sakimura K. 1937. The life and seasonal histories of *Thrips tabaci* Lind. in the vicinity of Tokyo, Japan. Oyo Dobuts Zasshi 9: 11-24.
- Sandhu G S. 1976. Record of bulb mite *Rhizoglyphus echinopus* (Fumouze and Robin) from stored onions in India. Science and Culture 42: 221-222.
- Sanjta S, Chauhan U. 2015. Survey of thrips (Thysanoptera) and their natural enemies in vegetables from mid-hills of Himachal Pradesh. The Ecosan 9: 713-715.
- Sarwar M. 2012. Frequency of Insect and mite fauna in chilies Capsicum annum L., onion *Allium cepa* L. and garlic, *Allium sativum* L. cultivated areas, and their integrated management. International Journal of Agronomy and Plant Production 3: 173-178.
- Sasakawa M, 1961. A study of the Japanese Agromyzidae (Diptera) part 2. Pacific Insects 3: 307-472.
- Satyagopal K, Sushil S N, Jeyakumar P, Shankar G, Sharma O P, Boina D, Sain S K, Asre R, Kapoor K S, Arya S, Kumar S, Patni C S, Chattopadhyay C, Pawar S A, Shukla A, Usha B, Basanagoud K, Mishra H P, Suresh D, Ekabote AY, Thakare A S, Halepyati M B, Patil, A G, Sreenivas N, Sathyannarayana S, Latha. 2014. AESA based IPM package for onion. pp.50.
- Saxena R C. 1975. Integrated approach for the control of *Thrips tabaci* Lind. Indian Journal of Agricultural Sciences 45: 434-436.
- Scott D B. 1964. The economic significance of Collembola in the Salinas valley of California. Journal of Economic Entomology 57: 297-298.
- Shannon M, Russell L G, Nault B A, Kennedy G G. 2008. Temperature and precipitation affect seasonal patterns of dispersing tobacco thrips, *Frankliniella fusca*, and onion thrips, *Thrips tabaci* (Thysanoptera: Thripidae) caught on sticky traps. Environmental Entomology 37: 79-86.
- Shelton A M, Becker R F, Andaloro J T. 1983. Varietal resistance to onion thrips (Thysanoptera: Thripidae) in processing cabbage. Journal of Economic Entomology 76: 85-86.
- Shiao S F. 2004. Morphological diagnosis of six *Liriomyza* species

- (Diptera: Agromyzidae) of quarantine importance in Taiwan. *Applied Entomology and Zoology* 39: 27-39.
- Simoglou K B, Roditakis E, Martinez M, Roditakis and N E. 2008. First record of *Phytomyza gymnostoma* Loew (Diptera: Agromyzidae) a leaf mining pest of leeks in Greece. *EPPPO Bulletin* 38: 507-509.
- Skoracka A, Kuczyński L, Szydło W, Brian R. 2013. The wheat curl mite *Aceria tosichella* (Acari: Eriophyidae) is a complex of cryptic lineages with divergent host ranges: evidence from molecular and plant bioassay data. *Biological Journal of the Linnean Society* 109: 165-180.
- Soumia P S, Karuppaiah V, Mahajan V, Singh M. 2020. Beet Armyworm *Spodoptera exigua*: Emerging threat to onion production. *National Academy Science Letters* DOI: 10.1007/s40009-020-00892-5
- Specht A, Andres O Angulo, Tania S, Olivares, Fronza E, Vânia F, Roque-Specht, Valduga E, Albrecht F, Poletto G, Neiva M Barros. 2013. Life cycle of *Agrotis malefida* (Lepidoptera: Noctuidae): A diapausing cutworm. *Zoologia* 30: 371-378.
- Spencer K A. 1973. Agromyzidae (Diptera) of economic importance. *Series Entomologica* 9. Dr W Junk, The Hague. 418pp.
- Spencer K A. 1976. The Agromyzidae (Diptera) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica* 5: 1-606.
- Srinivas P S, Lawande K E. 2004. Red spider mite, *Tetranychus cinnabarinus* was observed on garlic and onion plants grown in cages during the rabi. *Insect Environment* 10: 79-80.
- Srinivas P S, Singh R P, Lawande K E. 2007. Integrated pest and disease management in onion and garlic. *Technical Bulletin No.17*. Directorate of Onion and Garlic Research, Rajgurunagar, Pune, Maharashtra. 34 pp.
- Stegmaier C E. 1966. Host plants and parasites of *Liriomyza trifolii* in Florida (Diptera: Agromyzidae). *Florida Entomologist* 49: 75-80.
- Sulvai F, Chauque B J M, Macuvele D L P. 2016. Intercropping of lettuce and onion controls caterpillar thread, *Agrotis ipsilon* major insect pest of lettuce. *Chemical Biological Technologies in Agriculture* 3: 28.
- Szwejdka J, Wrzodak R. 2009. Phytophagous entomofauna occurring on onion plantations in Poland in years 1919-2007. *Vegetable Crops Research Bulletin* 71: 5-14.
- Toda S, Morishita M. 2009. Identification of three point mutations on the sodium channel gene in pyrethroid-resistant *Thrips tabaci* (Thysanoptera: Thripidae). *Journal of Economic Entomology* 102: 2296-3000.
- Tommasini M G. 2003. Evaluation of *Orius* species for biological control of *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae). PhD dissertation, Wageningen University, Netherlands.
- Ueno T. 2006. Current status of insect pests attacking green bunching onion in central and southern Vietnam. *Journal of the Faculty of Agriculture, Kyushu University* 51: 275-283.
- Ueno T. 2015. Beet Armyworm *Spodoptera exigua* (Lepidoptera: Noctuidae): a major pest of welsh onion in Vietnam. *Journal of Agriculture and Environmental Sciences* 4: 181-185.
- USDA APHIS. 2016. New Pest Advisory Group (NPAG) Report. *Phytomyza gymnostoma* Loew: onion leaf miner. pp. 1-7.
- USDA. 1932. Insect Pest Survey. *Feltia gladiaria* Morr was scarce on onions at Kosciusko, Miss. The clay backed cutworm occasioned serious injury in central and Northern Illinois 13: 145.
- Velasquez Z L D. 1988. Ciclo biológico de *Copitarsia turbata* (Lep.: Noctuidae) sobre cebolla, en Arequipa. *Review of Peru Entomology* 30: 108-110.
- Venette R C, Gould J R. 2006. A pest risk assessment for *Copitarsia* spp. Insects associated with importation of commodities into the United States. *Euphytica* 148: 165-183.
- Venkatesh D, David P M M. 2001. Some observations on the fig moth, *Cadra cautella* (Wlk.) infesting onions in storage. *Entomon* 26: 323-326.
- Verma S C. 2011. Record of cigarette beetle *Lasioderma serricorne* F (Coleoptera: Anobiidae) on onion seeds. *International Journal of Farm Sciences* 1: 59-60.
- Wagan T A, Hua H X, He Y P, Wagan S A, Baloch S K. 2014. Seasonal incidence of insect pest and natural enemies on onion agroecosystem at Tandojam, Pakistan. *Journal of Biology, Agriculture and Healthcare* 4: 205-212.
- Wakamura S, Takai M, Kozai S, Inoue H, Yamashita I, Kawahara S, Kawamura M. 1989. Control of the beet armyworm, *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae), using synthetic sex pheromone I. Effect of communication disruption in Welsh onion fields. *Applied Entomology and Zoology* 24: 387-397.
- Wang J Z, QianXiang R. 2004. The trials of 48% Lorsban EC to *Bradysia odoriphaga* and *Delia antiqua* on garlic fields. *China Vegetables* 4: 38-39.
- Weintraub P G, Scheffer S J, Visser D, Valladares G, Soares Correa A, Shepard B M, Rauf A, Murphy S T, Mujica N, MacVean C, Kroschel J, Kishinevsky M, Joshi R C, Johansen N S, Hallett R H, Civelek H S, Chen B, Metzler H B. 2017. The invasive *Liriomyza huidobrensis* (Diptera: Agromyzidae): understanding its pest status and management globally. *Journal of Insect Science* 17: 28.
- Whelan D B. 1935. A key to the Nebraska cutworms and armyworms that attack corn. The description, distribution, seasonal abundance, habits, and food plants of the clay-backed cutworm, *Feltia gladiaria* Morrison, are discussed. Host plants include corn, clover, tobacco, potato, tomato, sweet potato, bean, onion, raspberry, oats, grass, aster, goldenrod, and pansy. *Nebraska Agricultural Experimental Station Research Bulletin* 81: 1-27.
- Wilcox J. 1926. The Lesser bulb fly, *Eumerus strigatus* Fallen, in Oregon. *Journal of Economic Entomology* 19: 762-772.
- Yang J K, Zhang X M. 1985. Notes on the fragrant onion gnats with descriptions of two new species of *Bradysia odoriphaga* (Diptera: Sciaridae). *Journal of China Agriculture University* 10: 153-158.
- Zaazou H, El Deeb A, Hammad S M, El-Kady E A. 1960. The dried-fruit beetle: *Carpophilus hemipterus* L. (Coleoptera: Nitidulidae) and its occurrence in Egyptian onions from March, 1953 until April, 1954. *Alexandria Journal of Agricultural Research* 8: 105-24.
- Zheng S J, Henken B, Wietsma W, Sofiari E, Jacobsen E, Krens F A, Kik C. 2000. Development of bio-assays and screening for resistance to beet armyworm (*Spodoptera exigua* Hübner) in *Allium cepa* L. and its wild relatives. *Euphytica* 114: 77-85.

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Table 1. Checklist of insect pests of onion

S. No.	Order/ Family/ Common Name/ Scientific Name	Distribution	Nature of feeding	Damaging stage	Reference
<b>Coleoptera</b>					
<b>Chrysomelidae</b>					
1	Onion beetle, <i>Lilioceris merdigera</i> (L., 1758)	Poland, Iran	Seedlings	Larva / grub	Luczak (1994); Szwejd and Wrzodak (2009)
2	Flea beetle <i>Altica</i> sp	India	Leaf	Larva / grub	Kaundal and Sood (2021)
<b>Curculionidae</b>					
3	Weevil, <i>Ceuthorrhynchus jakovlevi</i> Schultze, 1902	Poland	Seedlings	Larva / grub	Ruszkowska (1952); Osmolowski (1980); Szwejd and Wrzodak (2009)
4	<i>Ceuthorrhynchus suturalis</i> F., 1775	Poland	Seedlings	Larva / grub	Jerzy and Robert (2009)
<b>Dermestidae</b>					
5	<i>Anthrenus jordanicus</i> Pic, 1934	India	Bulb	Grub and Adult	Chandel et al. (2016)
6	<i>Anthrenus oenicus</i> Fauvel, 1903	India	Bulb	Grub and Adult	Chandel et al. (2016)
<b>Elateridae</b>					
7	Wireworm, <i>Agriotes lineatus</i> (L., 1767)	Poland	Seedlings	Larva / grub	Szwejd and Wrzodak (2009)
8	Wheat wireworm, <i>Agriotes mancus</i> (Say, 1823)	USA	Root	Grub and Adult	Chittenden (1913)
9	Wireworm, <i>Anthos</i> sp	Poland	Seedlings	Larva / grub	Szwejd and Wrzodak (2009)
<b>Nitidulidae</b>					
10	Dried fruit beetle, <i>Carpophilus hemipterus</i> (L., 1758)	Egypt	Bulb	Nymph and adult	Zaazou et al. (1960); Sabra et al. (2011); Ibrahim et al. (1970); Abu-Hashish (1998)
11	Dried fruit beetle, <i>Carpophilus immaculatus</i> Lucas, 1849	Egypt	Bulb	Nymph and adult	Sabra et al. (2011)
12	Dried fruit beetle, <i>Carpophilus obsolutus</i> Erichson, 1843	India, Egypt	Bulb	Nymph and adult	Gupta et al. (1991)
<b>Anobiidae</b>					
13	Cigarette beetle, <i>Lasioderma serricorne</i> (F., 1972)	Egypt	Bulb, Seed	Nymph and adult	Dimetry et al. (1978); Verma (2011)
<b>Scarabaeidae</b>					
14	Cockchafer, <i>Melolontha melolontha</i> (L., 1758)	Poland	Seedlings	Larva / grub	Szwejd and Wrzodak (2009)
15	Cockchafer, <i>Melolontha hippocastani</i> F., 1801	Poland	Seedlings	Larva / grub	Szwejd and Wrzodak (2009)
16	Cockchafer, <i>Melolontha furicicauda</i> Ancy	India	Seedlings	Larva / grub	Kaundal (2018)
17	<i>Phyllophaga</i> sp	USA	Seedlings	Larva / grub	Hall et al. (2011)
18	Hairy beetle, <i>Tropinota squalidae</i> (Scopoli, 1783)	Egypt	Leaf/ Flower	Adult	Elbolok et al. (1990)
<b>Dynastidae</b>					
19	Potato scabid, <i>Pentodon bispinosus</i> Kust, 1852	Egypt	Leaf	Adult	Elbolok et al. (1990)
<b>Meloidae</b>					
20	Nuttall blister beetle, <i>Lytta nuttalli</i> Say, 1824	US	Leaf	Adults	Capinera (2001)
<b>Collembola</b>					
<b>Onychiuridae</b>					
21	Springtails, <i>Onychirus armatus</i> (Tulberg, 1869)	Tasmania	Root	Nymph and adult	Ireson (1990); Ireson (1993)

(contd.)



22	Springtails, <i>Onychirus fimatarius</i> Stach, 1934	Tasmania	Root	Nymph and adult	Ireson (1990)
23	Springtails, <i>Onychirus ambulans</i> (L., 1758)	Tasmania	Root	Nymph and adult	Ireson (1990)
<b>Entomobryidae</b>					
24	Springtails, <i>Entomobrya unostrigata</i> Stach, 1930	USA	Root	Nymph and adult	Scott (1964)
Bourletiellidae					
25	Garden springe tails, <i>Bourletiella hortensis</i> (Fitch, 1863)	Tasmania	Root	Nymph and adult	Ireson (1990); Mills (1930)
<b>Sminthuridae</b>					
26	Garden springtails, <i>Siminithurus viridis</i> (L., 1758)	New Zealand	Root	Nymph and adult	Munro (2007)
<b>Dermaptera</b>					
<b>Furculidae</b>					
27	Ringlegged earwig, <i>Euborellia annulipes</i> (Lucas, 1847)	India	Bulb, Seedlings	Nymph and adult	Hill (1983); Chandel et al. (2016)
<b>Diptera</b>					
<b>Agromyzidae</b>					
28	Allium leaf miner, <i>Phytomyza gymnostoma</i> Loew, 1858	UK, Denmark, USA	Leaf	Larva	Coman and Rosca (2011); Spencer (1976); Simoglou et al. (2008); Collin and Loe (2005); USDA (2016); Barringer et al. (2018)
29	Vegetable leaf miner, <i>Liriomyza huidobrensis</i> (Blanchard, 1926)	Chile, Peru, China, Columbia, Costa Rica, Germany, Guatemala, Indonesia, Kenya, Philippines, Spain, Taiwan, Vietnam	Leaf	Larva	Mujica et al. (2011); Weintraub et al. (2017); Andersen et al. (2008)
30	Vegetable leaf miner, <i>Liriomyza sativae</i> Blanchard, 1938	Hawaii, North America, Vietnam	Leaf	Larva	Carolina and Johnson (1992); Andersen et al. (2008); Chen et.al (2003)
31	American serpentine leaf miner, <i>Liriomyza trifolii</i> (Burgess, 1880)	Philippines, Hawaii, Vietnam	Leaf	Larva	Stegmaier (1966); Arida et al. (2013); Ronald and Jayma (2007); Andersen et al. (2008)
32	<i>Liriomyza chinensis</i> (Kato, 1949)	China, Japan, Malaysia, Singapore, Thailand, Korea Vietnam and Taiwan	Leaf	Larva	Spencer, (1973); Chen et al. (2003); Hwang and Moon (1995); Andersen et al. (2002); Shiao (2004); Ueno (2006); Chen et.al (2003)
33	Pea leaf miner, <i>Chromatomyia horticola</i> Goureau, 1851	Poland, Croatia, India, Vientnam	Leaf	Larva	Gupta et al. (1985); Szwedza and Wrzodac (2009); Mesic and Barcic (2004); Andersen et al. (2008); Kaundal and Sood (2021)
34	Onion leaf miner, <i>Liriomyza cepae</i> (Hering, 1927)	Europe, Malaya, China, Japan	Leaf	Larva	Sasakawa (1961)
35	Turnip leaf miner, <i>Scaptomyza flava</i> Fallen, 1823	New Zealand	Leaf	Larva	Martin (2004)
<b>Anthomyiidae</b>					
36	Onion fly, <i>Delia antiqua</i> (Meigen, 1826)	Asia, Africa, North and South America, Europe	Bulb, Pseudo-stem	Maggot	Wang and Xiang (2004); Rozkosny (1997); Griffiths (1993); Pont (1974); Henning (1974)

(contd.)

37	Been fly, <i>Delia platura</i> (Meigen, 1826)	Australia Europe north and South America, North Africa, Japan, India, New Zealand	Bulb, Pseudo- stem	Maggot	Ellis and Scatcherd (2007); Hamilton and Toffolon (1986); CIE (1985); Chaudhary et al. (1987); Idinger (1995); Pont and Ackland (1980); Pont (1974); Munro (2007)
38	Been fly, <i>Delia florilega</i> (Zetterstedt, 1845)	Australia; Europe North and South America, North Africa, Japan, India, New Zealand	Bulb, Pseudo- stem	Maggot	Ellis and Scatcherd (2007)
39	Onion maggot, <i>Delia alliria</i> Fonseca, 1965	Egypt	Bulb	Maggot	Elbolok et al. (1990); Awadalla et al. (2011)
40	Root maggot, <i>Pegomya cepetorum</i> Meade, 1883	USA	Bulb	Maggot	Chittenden (1913)
41	Seed corn maggot, <i>Pegomya fusciceps</i> (Zetterstedt, 1845)	USA	Roots/ Stalks	Maggot	Chittenden (1913)
<b>Drosophilidae</b>					
42	Fruit fly, <i>Drosophila busckii</i> Conquillet, 1901	USA	Bulb	Larva	Merrill and Hutson (1953)
43	Leaf mining fly, <i>Scaptomyza flava</i> Fallen (1823)	New Zealand	Leaf	Larva	Munro (2007)
<b>Ephydriidae</b>					
44	Rice leaf miner, <i>Hydrellia griseola</i> (Fallen, 1823)	Florida, (USA); USSR	Leaf	Larva	Hesler (1995); Isaev (1931)
<b>Fanniidae</b>					
45	Lesser housefly, <i>Fannia canicularis</i> (L., 1761)	Poland, USA	Bulb	Larva	Szwejdka and Wrzodak (2009); Merrill and Hutson (1953)
46	Latrine fly, <i>Fannia scalaris</i> (F., 1794)				
47	<i>Fannia leucosticta</i> (Meigen, 1838)				
48	<i>Fannia manicata</i> (Meigen, 1826)				
<b>Heleomyzidae</b>					
49	Garlic fly, <i>Suillia lurida</i> Meigen, 1830	Poland, Iran	Bulb	Larva	Szwejdka and Wrzodak (2009)
<b>Ortalidae</b>					
50	Barred winged onion fly, <i>Chatopsis anea</i> (Wiedemman, 1830)	USA, Canada	Root	Maggot	Chittenden (1913)
<b>Ulidiidae</b>					
51	Black onion fly, <i>Tritoxa flexa</i> (Wiedemman, 1830)	USA, India	Root	Maggot	Chittenden (1913); Chandel et al. (2016)
52	Picture winged fly, <i>Chaetopsis massyla</i> (Walker, 1849)	Canada	Bulb	Larva	Merrill (1951)
<b>Muscidae</b>					
53	Pepper fruit fly, <i>Atherigona orientalis</i> Schiner, 1868	Egypt, India	Bulb	Maggot	Mahmoud (2008); Gupta et al. (1991); Sabra et al. (2011); Merrill and Hutson (1953); Szwejdka and Wrzodak (2009)
54	False stable fly, <i>Muscina levida</i> (Harris, 1780)	Brazil, Poland, USA	Rotten bulb	Maggot	Merrill and Hutson (1953); Szwejdka and Wrzodak (2009)
55	Fly, <i>Muscina assimilis</i> Fallen, 1823	Poland, USA	Bulb	Maggot	Carvalho et al. (2005); Merrill and Hutson (1953); Szwejdka and Wrzodak (2009)
56	Fly, <i>Muscina stabulans</i> Fallen, 1817	Poland, USA	Bulb	Maggot	Carvalho et al. (2005); Merrill and Hutson (1953); Szwejdka and Wrzodak (2009)

(contd.)

<b>Sciaridae</b>					
57	Dark winged fungus gnat, <i>Bradysia odoriphaga</i> Yang and Zhang, 1985	China	Root, Bulb, Pseudo-stem	Larva	Yang and Zhang (1985); Arimoto et al. (2018)
<b>Syrphidae</b>					
58	Onion bulb fly, <i>Eumerus amoenus</i> Loew, 1848	Egypt	Bulb	Maggot	El-Sherif and Mahmoud (2008); Haydar and El-Sherif (1987); Sabra et al. (2011)
59	Lesser bulb fly, <i>Eumerus strigatus</i> (Fallen, 1817)	United States, New Zealand, England; Poland, Australia, Egypt	Bulb	Maggot	Collin (1920); Braodbet (1925); Wilcox (1926); Doane (1983); Hodson (1927); Bankowska (1980)
60	Lesser bulb fly, <i>Eumerus tuberculatus</i> Rondani, 1857	England, Poland, Florida (USA)	Bulb	Maggot	Collin (1920); Bankowska (1980)
61	Lesser bulb fly, <i>Eumerus narcissi</i> Smith, 1928	Florida (USA), Oregon, UK	Bulb	Maggot	Wilcox (1926); Hodson (1932)
62	Onion bulb fly, <i>Eumerus vestitus</i> Bez	Egypt	Bulb	Maggot	Elbolok et al. (1990)
63	Onion bulb fly, <i>Syrrita spinigera</i> Lw	Egypt	Leaf	Adult	Elbolok et al. (1990)
<b>Hemiptera</b>					
<b>Aphididae</b>					
64	Shallot aphid, <i>Myzus ascalonicus</i> Doncaster, 1946	Europe, New Zealand	Leaf	Nymph and adult	Munro (2007)
65	Mustard aphid, <i>Lipaphis erysimi</i> (Kaltenbach, 1843)	Europe; Barbados	Leaf	Nymph and adult	Hill (1983); Braithwaite (1983)
66	Shallot aphid, <i>Myzus persicae</i> (Sulzer, 1776)	Europe	Leaf	Nymph and adult	Hill (1983)
67	Black onion aphid, <i>Neotoxoptera formosana</i> (Takahashi, 1921)	Europe, Japan, New Zealand	Leaf	Nymph and adult	Hori (2007); Piron (2010); Munro (2007)
68	Violet aphid, <i>Neotoxoptera violae</i> (Pergande, 1900)	Italy, Netherland, France	Leaf	Nymphs and adult	Barbagallo and Ciampolini (2000); Piron (2010)
69	Marigold aphid, <i>Neotoxoptera oliveri</i> (Essig, 1935)	New Zealand	Leaf	Nymphs and adult	Munro (2007)
70	Cotton aphid, <i>Aphis gossypii</i> Glover, 1877	Egypt	Leaf	Nymph and adult	Awadalla et al. (2017)
71	Foxglove aphid, <i>Aulacorthum solani</i> (Kaltenbach, 1843)	Europe	Leaf	Nymph and adult	Hill (1983)
<b>Aleyrodidae</b>					
72	Cotton and tomato white fly, <i>Bemisia tabaci</i> (Gennadius, 1889)	Egypt	Leaf	Nymph and adult	Elbolok et al. (1990)
<b>Cicadellidae</b>					
73	Leaf hopper, <i>Empoasca decipines</i> Paoli, 1930	Egypt	Leaf	Nymph and adult	Elbolok et al. (1990)
74	Leaf hopper, <i>Balclutha hortensis</i> Lindberg, 1954	Egypt	Leaf	Nymph and adult	Elbolok et al. (1990)
75	Jassid, <i>Amrasca biguttula biguttula</i> Ishida, 1912	India	Leaf	Nymph and adult	Gupta et al. (2016); Kumar et al. (2017)
76	Ash leaf hopper, <i>Macrostoteles fascifrons</i> (Stal, 1858)	India	Leaf	Nymph and adult	Chandel et al. (2016)
<b>Delphacidae</b>					
77	Plant hopper, <i>Sogatella vibix</i> (Haupt, 1927)	Egypt	Leaf	Nymph and adult	Elbolok et al. (1990)
<b>Pentatomidae</b>					
78	Southern green stink bug, <i>Nezara viridula</i> (L., 1758)	Egypt	Leaf	Nymph and adult	Elbolok et al. (1990)
79	Shield bug, <i>Carpocoris fuscipinus</i> Boh, 1851	Poland	Leaf		Jerzy and Robert (2019)

(contd.)

80	Shield bug, <i>Dolycoris baccarum</i> L., 1785 <b>Triozidae</b>	Poland	Leaf	Nymph and adult	Jerzy and Robert (2019)
81	Psyllid, <i>Triozza brassicae</i> Vasiliev, 1922 <b>Hymenoptera</b> <b>Formicidae</b>	Poland	Leaf	Nymph and adult	Jerzy and Robert (2019)
82	Red ant, <i>Solenopsis</i> sp <b>Lepidoptera</b> <b>Acrolepiidae</b>	Ethiopia	Bulb	Adult	Haile et al (2016)
83	Asiatic onion leaf miner, <i>Acrolepiopsis sapporensis</i> Matsumura, 1931	Korea, Japan	Leaf	Larva	Park (2015); Rabinowitch and Brewster (1990)
84	Leek moth, <i>Acrolepiopsis assectella</i> (Zeller, 1839) <b>Geometridae</b>	North America	Leaf, bulb	Larva	Olmstead and Shelton (2012); Harmatha et al. (1987); Mason et al. (2011)
85	The loop worm, <i>Gymnoscelis pumilata</i> (Hubner, 1813) <b>Cosmopterygidae</b>	Egypt	Leaf	Larva	Elbolok et al. (1990)
86	Pyroderces moth, <i>Pyroderces simplex</i> Wlsm 1891 <b>Noctuidae</b>	Egypt	Leaf	Adult	Elbolok et al. (1990)
87	Beet army worm, <i>Spodoptera exigua</i> (Hubner, 1808)	Netherlands, Japan, Korea, North America, Egypt, Philippines, Vietnam, India	Leaf / Umbel	Larva	Wakamura et al. (1989); Ueno (2006); Ueno (2015); Zheng et al. (2000); Heppner (1998); Arida et al. (2004); Rao (1998); Elbolok et al. (1990); Kang et al. (2008); Park and Goh (1992); Soumia et al. (2020)
88	Cutworm, <i>Spodoptera litura</i> (F., 1775)	India, Philippines	Leaf / Umbel	Larva	Prasad and Shrishya (2009); Arulkumar et al (2017); Arida et al. (2004); Rao (1998)
89	Cotton leafworm, <i>Spodoptera littoralis</i> (Boisduval, 1833)	Barbados, Africa, Europe	Leaf	Larva	Brathwaite (1983); EFSA (2015); Elbolok et al. (1990)
90	Black cutworm, <i>Agrotis ipsilon</i> (Hufnagel, 1766)	Mozambique, India, Egypt, Canada, South America	Leaf, root, pseudo-stem	Larva	Sathyagopal et al. (2014); Sulvai et al. (2016); Elbolok et al. (1990); Rabinowitch and Brewster (1990); Specht et al. (2013)
91	Pale-Sided Cutworms, <i>Agrotis malefida</i> Guenee, 1852	Brazil	Leaf, root, pseudo-stem	Larva	
92	Old world boll worm, <i>Helicoverpa armigera</i> (Hubner, 1809)	India, Pakistan, Burkina Faso	Leaf and umbel	Larva	Rai et al. (1979); Ahmed et al. (2019); Rubiya et al. (2019); Srinivas et al. (2007)
93	Green looper, <i>Chrysodeixis acuta</i> (Walker, 1858)	India	Leaf	Larva	Karuppaiah et al. (2019)
94	Semilooper, <i>Trichoplusia orichalcea</i> F., 1775	India	Leaf	Larva	Kaundal (2018)
95	Oriental tobacco budworm, <i>Heliothis assulta</i> Guenee, 1852	Papua NG, Australia	Leaf	Larva	Hill (1983); Cho and Boo (1988); Cork et al. (1992)
96	Large yellow under wing, <i>Noctua pronuba</i> L., 1758	North America	Seedlings/ leaf	Larva	Bechinski et al. (2009)
97	Turnip moth, <i>Agrotis segetum</i> (Denis & Schiffermüller, 1775)	U.K	Leaf	Larva	Rabinowitch and Brewster (1990)
98	Leaf worm, <i>Copitarsia</i> spp	Chile, Peru	Leaf	Larva	Valasquez (1988); Venette and Gould (2006); Rabinowitch Brewster (1990)

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99	Turnip moth/yellow cutworm, <i>Scotia segetum</i> (Denis and Schiffermüller, 1775)	Denmark	Pseudo-stem / leaf	Larva	Esbjerg et al. (1995)
100	Garden dart moth, <i>Euxoa nigricans</i> (L., 1761)	Europe	Pseudo-stem, leaf, Seedling	Larva	Carter (1984); Rabinowitch Brewster (1990)
101	Whiteline dart moth, <i>Euxoa tritici</i> (L., 1761)	Europe	Seedling / leaf	Larva	Rabinowitch Brewster (1990)
102	Army worm, <i>Faronta</i> spp	Chile	Stem	Larva	Rabinowitch Brewster (1990)
103	Onion stem borer, <i>Hydraecia mongoliensis</i> (Urbahn, 1967)	Japan	Pseudo-stem / leaf	Larva	Saito (1984); Iinuma and Saito (1988)
104	Cabbage moth, <i>Mamestra brassicae</i> (L., 1758)	UK	Leaf	Larva	Rabinowitch Brewster (1990)
105	Variegated cutworm, <i>Peridroma saucia</i> (Hubner, 1808)	USA	Pseudo-stem / leaf	Larva	Rabinowitch Brewster (1990)
106	Variegated cutworm, <i>Peridroma margaritosa</i> Haw.	USA	Pseudo-stem / leaf	Larva	Chittenden (1913)
107	Army cutworm, <i>Chorizagrotis auxiliaries</i> (Grote, 1873)	USA	Pseudo-stem / leaf	Larva	Whelan (1935)
108	Dark-sided cutworm, <i>Euxoa messoria</i> (Harris, 1841)	USA	Pseudo-stem / leaf	Larva	Chittenden (1913)
109	Striped Cutworm, <i>Euxoa tessellata</i> (Harris, 1841)	USA	Pseudo-stem / leaf	Larva	Chittenden (1913)
110	Dark-sided cutworm, <i>Euxoa punctigera</i> (Walker, 1865)	UAS	Stem / leaf	Larva	Chittenden (1913)
111	Clay-backed cutworm, <i>Feltia gladiaria</i> Morrison, 1875	USA	Pseudo-stem / leaf	Larva	USDA (1932)
112	Spotted cutworm, <i>Agrotis c-nigrum</i> L., 1758	USA	Pseudo-stem / leaf	Larva	Whelan (1935)
113	Moth, <i>Margarita stricticalis</i>	Poland	Pseudo-stem / leaf	Larva	Jerzy and Robert (2009)
<b>Pieridae</b>					
114	Cabbage worm, <i>Pieris rapae</i> (L., 1758)	Egypt	Leaf	Adult	Elbolok et al. (1990)
<b>Pyralidae</b>					
115	Christmas berry webworm, <i>Cryptoblabes gnidiella</i> (Milliere, 1867)	Egypt, US	Bulb		Rabinowitch Brewster (1990); Molet (2013)
116	Almond moth, <i>Ephestia cautella</i> (Walker, 1864)	India, Egypt	Bulb	Larva	Vengatesh and David (2001); Sabra et al. (2011)
117	Mediterranean flour moth, <i>Ephestia kuehniella</i> (Zeller, 1879)	Egypt	Bulb	Larva	Elbolok et al. (1990)
118	Indian meal moth, <i>Plodia interpunctella</i> (Hubner, 1813)	Egypt	Bulb	Larva	Elbolok et al. (1990); Ja HyunNa and Rayoo (2000)
119	Beet webworm, <i>Loxostege sticticalis</i> (L., 1761)	North America	Pseudo Stem / Leaf	Larva	Capinera (2001)
<b>Tineidae</b>					
120	Garlic moth, <i>Cryptoblabes gnidiella</i> (Milliere, 1867)	Egypt	Leaf / bulb	Larva	Elbolok et al. (1990)
<b>Toricidae</b>					
121	Cyclamen tortrix, <i>Clepsia spectrana</i> (Treitschke, 1830)	UK	Leaf	Larva	Rabinowitch Brewster (1990)
122	Carnation tortrix, <i>Cacoecimorpha pronubana</i> (Hubner, 1799)	France	Leaf	Larva	Rabinowitch Brewster (1990)
<b>Orthoptera</b>					
<b>Gryllotalpidae</b>					
123	Common mole cricket, <i>Gryllotalpa gryllotalpa</i> (L., 1758)	Poland, Egypt	Leaf/ Pseudo-stem	Nymph and adult	Szwejdka and Wrzodak (2009);

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<b>Acrididae</b>					
124	Egyptian locust, <i>Anacridium aegyptium</i> (L., 1758)	Egypt	Leaf	Adult	Elbolok et al. (1990)
125	Clover grass hopper, <i>Euprepocnemis plorans</i> (Charpentier, 1825)				
126	Grasshopper, <i>Attractomorpha sinensis</i> Bolivar, 1905	Pakistan	Leaf	Nymph and adult	Sarwar (2012)
Gryllidae					
127	Black field cricket, <i>Liogryllus bimaculatus</i> (de Geer, 1773)	Egypt	Root, Bulbs	Nymph and adult	Elbolok et al. (1990)
128	Field cricket, <i>Brachytrupes portentosus</i> Licht, 1976	India	Root, Bulbs	Nymph and adult	Kaundal (2018)
129	Field cricket, <i>Gryllus pennsylvanicus</i> Burmeister, 1938	Pakistan	Root, Bulbs	Nymph and adult	Wagan et al. (2014)
Tettigoniidae					
130	Grasshopper, <i>Eucanocephalus</i> sp	India	Leaf	Nymph and adult	Kaundal (2018)
<b>Thysanoptera</b>					
<b>Thripidae</b>					
131	Onion thrips, <i>Thrips tabaci</i> Lindeman, 1889	India, New Zealand, North America, Egypt, Australia	Leaf, bulb	Nymph and adult	Sakimura (1937); Passlow (1957); Lall and Singh (1968); Saxena (1975); Coudriet et al. (1979); Shelton et al. (1983); Toda and Morishita (2009); Gill et al. (2015); Srinivas et al. (2007); Diaz-Montano et al. (2010); Kendall and Capinera (1990); MacIntyre-Allen et al.(2005); Martin et al. (2006); Murai and Toda (2002); Pobożniak et al. (2016); Pozzer et al. (1999); Awadalla et al. (2017)
132	Western Flower Thrips, <i>Frankliniella occidentalis</i> Perganda, 1895	North America; Netherlands; China	Leaf,	Nymph and adult	Tommasini (2003); Mantel and Van de Vrie (1988); Kirk and Terry (2003); Coviello, et al. (1995); Reitz et al. (2011)
133	Tobacco thrips, <i>Fancciniella fusca</i> (Hinds, 1902)	Japan, North America	Leaf , bulb	Nymph and adult	Shannon et al. (2008); Nakao et al. (2011)
134	Cabbage thrips, <i>Thrips angusticeps</i> Uzel, 1895	Europe	Leaf	Nymph and adult	Hurej et al. (2017)
135	Melon thrips, <i>Thrips palmi</i> Karny, 1925	India	Leaf	Nymph and adult	Sanjta and Chauhan (2015); Kaundal (2018)
136	Yellow flower thrips, <i>Thrips flavus</i> Schrank, 1776	India	Leaf	Nymph and adult	Sanjta and Chauhan (2015); Kaundal (2018)
137	Groundnut thrips, <i>Caliothrips indicus</i> Bagnall, 1913	India	leaf	Nymph and adult	Hill (1983)
<b>Non-insect pests</b>					
<b>Sarcoptiforms</b>					
<b>Acaridae</b>					
138	Bulb mite, <i>Rhizoglyphus callae</i> Oudemans, 1924	Argentina	Leaf, bulb	Nymph and adult	Ho (2008)
139	Bulb mite, <i>Rhizoglyphus robini</i> Claparède, 1869	Australia, New Zealand, USA, Japan, South America, UK, Egypt, China, Korea, India	Leaf, bulb	Nymph and adult	Hai fan and Zhang (2003); Manson (1972); Srinivas et al. (2007) Kuwarhara (1988); Ho (2008). Diaz et al. (2000)

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140	Bulb mite, <i>Rhizoglyphus echinopus</i> (Fumouze and Robin, 1868)	India, Australia, New Zealand, Russia	Leaf, bulb	Nymph and adult	Sandhu (1976); Hai fan and Zhang (2003)
141	Bulb mite, <i>Rhizoglyphus setosus</i> (Manson, 1972)	Taiwan	Leaf, bulb	Nymph and adult	Diaz et al. (2000); Chen et al., (2002)
142	Bulb mite, <i>Caloglyphus krameri</i> (Berlese, 1923)	Iran	Bulb	Nymphs and adult	Ostovan and Kamali (1995);
143	Storage mite, <i>Tyrophagus</i> sp	Pakistan	Bulb	Nymphs and adult	Sarwar (2012)
<b>Trombidiforms</b>					
<b>Tetranychidae</b>					
144	Red spider mite, <i>Tetranychus cinnabarinus</i> (Boisduval, 1867)	India	Leaf	Nymph and adult	Srinivas and Lawande (2004);
145	Two spotted spider mite, <i>Tetranychus cucurbitacearum</i> Sayed, 1946	Egypt	Leaf, bulb	Nymph and adult	Abo El-ghar and Osman (2009);
146	Two spotted spider mite, <i>Tetranychus urticae</i> C.L.Koch, 1836	Argentina	Leaf	Nymph and adult	Greco et al. (2006)
147	Brown wheat mite, <i>Petrobia latens</i> (Muller, 1776)	Egypt	Leaf, pseudo-stem and seed stalks	Nymph and adult	Abo El-ghar and Osman (1973)
<b>Eriophyidae</b>					
148	Wheat curl mite, <i>Aceria tulipae</i> (Keifer, 1938)	Netherland, UK, China, Japan, United State, France, India	Leaf, bulb	Nymph and adult	Kiedrowicz et al. (2017); Navia et al. (2010); Conijin et al. (1996); Srinivas et al. (2007); Debnath and Karmakar (2013);
149	Wheat curl mite, <i>Aceria tosichella</i> Keifer, 1969	Russia, Brazil		Nymph and adult	Navia et al. (2006); Skoracka et al. (2013)