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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, Furficulidae, Ephydridae, 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*

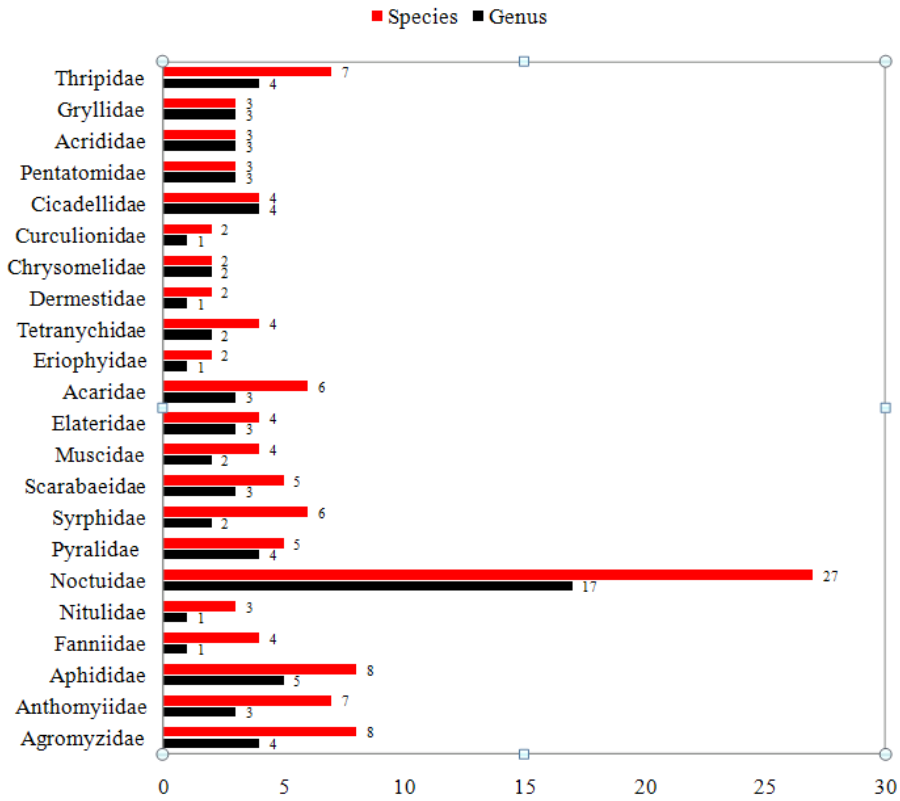

Fig. 1. Major insect families associated with onion

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

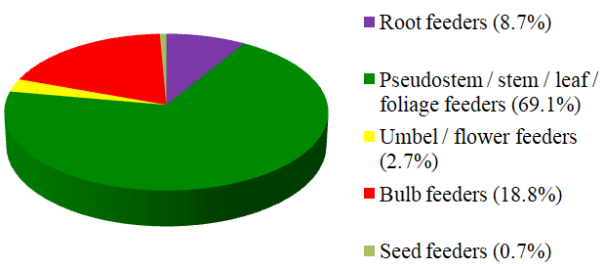

Fig. 2. Functional diversity of insect pests of onion

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* Ancey, *Nezara viridula* L., *Spodoptera litura* (F.), *T. tabaci* and *T. orichalacea* 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

Table 1. Checklist of insect pests of onion

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

(contd.)

22	Springtails, *Onychirus fimatarius* Stach, 1934	Tasmania	Root	Nymph and adult	Ireson (1990)
23	Springtails, *Onychirus ambulans* (L., 1758)	Tasmania	Root	Nymph and adult	Ireson (1990)
	Entomobryidae				
24	Springtails, *Entomobrya unostrigata* Stach, 1930 Bourletiellidae	USA	Root	Nymph and adult	Scott (1964)
25	Garden springe tails*, Bourletiella hortensis* (Fitch, 1863)	Tasmania	Root	Nymph and adult	Ireson (1990); Mills (1930)
	Sminthuridae				
26	Garden springtails, *Siminithurus viridis* (L., 1758)	New Zealand	Root	Nymph and adult	Munro (2007)
	Dermaptera				
	Furficulidae				
27	Ringlegged earwig, *Euborellia annulipes* (*Lucas*, 1847)	India	Bulb, Seedlings	Nymph and adult	Hill (1983); Chandel et al. (2016)
	Diptera				
	Agromyzidae				
28	Allium leaf miner*, Phytomyza gymnostoma* 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*, Liriomyza huidobrensis* (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, *Liriomyza sativae* 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, *Liriomyza trifolii* (*Burgess,* 1880)	Philippines, Hawaii, Vietnam	Leaf	Larva	Stegmaier (1966); Arida et al. (2013); Ronald and Jayma (2007); Andersen et al. (2008)
32	*Liriomyza chinensis* (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); Uneo (2006); Chen et.al (2003)
33	Pea leaf miner, *Chromatomyia horticola* Goureau, 1851	Poland, Croatia, India, Vientnam	Leaf	Larva	Gupta et al. (1985); Szwezda and Wrzodac (2009); Mesic and Barcic (2004); Andersen et al. (2008); Kaundal and Sood (2021)
34	Onion leaf miner, *Liriomyza cepae* (Hering, 1927)	Europe, Malaya, China, Japan	Leaf	Larva	Sasakawa (1961)
35	Turnip leaf miner, *Scaptomyza flava* Fallen, 1823	New Zealand	Leaf	Larva	Martin (2004)
	Anthomyiidae				
36	Onion fly, *Delia antiqua* (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, *Delia platura* (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, *Delia florilega* (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, *Delia alliria* Fonseca, 1965	Egypt	Bulb	Maggot	Elbolok et al. (1990); Awadalla et al. (2011)
40	Root maggot, *Pegomya cepetorum* Meade, 1883	USA	Bulb	Maggot	Chittenden (1913)
41	Seed corn maggot, *Pegomya fusciceps (Zetterstedt, 1845)*	USA	Roots/ Stalks	Maggot	Chittenden (1913)
	Drosophilidae				
42	Fruit fly, *Drosophila busckii* Conquillett, 1901	USA	Bulb	Larva	Merrill and Hutson (1953)
43	Leaf mining fly, *Scaptomyza flava* Fallen (1823)	New Zealand	Leaf	Larva	Munro (2007)
	Ephydridae				
44	Rice leaf miner, *Hydrellia griseola* (Fallen, 1823)	Florida, (USA); USSR	Leaf	Larva	Hesler (1995); Isaev (1931)
	Fanniidae				
45	Lesser housefly, *Fannia canicularis* (L., 1761)	Poland, USA	Bulb	Larva	Szwejda and Wrzodak (2009); Merrill and Hutson (1953)
46	Latrine fly, *Fannia scalaris* (F., 1794)				
47	*Fannia leucosticta* (Meigen, 1838)				
48	*Fannia manicata* (Meigen, 1826)				
	Heleomyzidae				
49	Garlic fly, *Suillia lurida* Meigen, 1830	Poland, Iran	Bulb	Larva	Szwejda and Wrzodak (2009)
	Ortalidae				
50	Barred winged onion fly, *Chatopsis anea* (Wiedemman,1830)	USA, Canada	Root	Maggot	Chittenden (1913)
	Ulidiidae				
51	Black onion fly, *Tritoxa flexa* (Wiedemman, 1830)	USA, India	Root	Maggot	Chittenden (1913); Chandel et al. (2016)
52	Picture winged fly, *Chaetopsis massyla* (Walker, 1849)	Canada	Bulb	Larva	Merrill (1951)
	Muscidae				
53	Pepper fruit fly, *Atherigona orientalis* Schiner, 1868	Egypt, India	Bulb	Maggot	Mahmoud (2008); Gupta et al. (1991); Sabra et al. (2011);
54	False stable fly, *Muscina levida* (Harris, 1780)	Brazil, Poland, USA	Rotten bulb	Maggot	Merrill and Hutson (1953); Szwejda and Wrzodak (2009)
55	Fly, *Muscina assimilis* Fallen, 1823	Poland, USA	Bulb	Maggot	Carvalho et al. (2005); Merrill and Hutson (1953); Szwejda and Wrzodak (2009)
56	Fly, *Muscina stabulans* Fallen, 1817	Poland, USA	Bulb	Maggot	Carvalho et al. (2005); Merrill and Hutson (1953); Szwejda and Wrzodak (2009)

(contd.)

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

(contd.)

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

(contd.)

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

(contd.)

	Acrididae				
124	Egyptian locust, *Anacridium aegyptium* (L., 1758)	Egypt	Leaf	Adult	Elbolok et al. (1990)
125	Clover grass hopper, *Euprepocnemis plorans* (Charpentier, 1825)				
126	Grasshopper, *Attractomorpha sinensis* Bolivar, 1905	Pakistan	Leaf	Nymph and adult	Sarwar (2012)
	Gryllidae				
127	Black field cricket, *Liogryllus bimaculatus* (de Geer, 1773)	Egypt	Root, Bulbs	Nymph and adult	Elbolok et al. (1990)
128	Field cricket, *Brachytrupes portentosus* Licht, 1976	India	Root, Bulbs	Nymph and adult	Kaundal (2018)
129	Field cricket, *Gryllus pennsylvanicus* Burmeister, 1938	Pakistan	Root, Bulbs	Nymph and adult	Wagan et al. (2014)
	Tettigoniidae				
130	Grasshopper, *Eucanocephalus* sp	India	Leaf	Nymph and adult	Kaundal (2018)
	Thysanoptera				
	Thripidae				
131	Onion thrips, *Thrips tabaci* 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, *Frankliniella occidentalis* 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, *Fancciniella fusca* (Hinds, 1902)	Japan, North America	Leaf , bulb	Nymph and adult	Shannon et al. (2008); Nakao et al. (2011)
134	Cabbage thrips, *Thrips angusticeps* Uzel, 1895	Europe	Leaf	Nymph and adult	Hurej et al. (2017)
135	Melon thrips, *Thrips palmi* Karny, 1925	India	Leaf	Nymph and adult	Sanjta and Chauhan (2015); Kaundal (2018)
136	Yellow flower thrips, *Thrips flavus* Schrank, 1776	India	Leaf	Nymph and adult	Sanjta and Chauhan (2015); Kaundal (2018)
137	Groundnut thrips, *Caliothrips indicus* Bagnall, 1913	India	leaf	Nymph and adult	Hill (1983)
			Non-insect pests		
	Sarcoptiforms				
	Acaridae				
138	Bulb mite, *Rhizoglyphus callae* Oudemans, 1924	Argentina	Leaf, bulb	Nymph and adult	Ho (2008)
139	Bulb mite, *Rhizoglyphus robini* Claparédè, 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)

(contd.)

(Table 1 contd.)

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

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).

AUTHOR CONTRIBUTION STATEMENT

All authors equally contributed.

CONFLICT OF INTEREST

No conflict of interest.

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