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Pests And Natural Enemies Determined In Olive Orchards in Turkey

R. BOZBUJ A Z. ELEK¢ĶOJ LU
Plant Protection Research Institute, Kışla Caddesi, PK:21, Köprüköy, 01321 Adana, TURKEY

*Corresponding Author
e-posta: nelekcioglu@yahoo.com

Abstract

In Turkey, pests are one of the most important problems in olive orchards. About 144 different olive pests were observed out of which 8 pests have to be considered as key pests (*Bactoracera oleae* Gmel., *Prays oleae* Bern, *Saissetia oleae* Olivier, *Parlatoria oleae* Colvèe, *Euphyllura olivina* Costa, *Calocoris trivialis* Costa, *C. annulus* Costa, *Pollinia pollini* Costa). For most pests a lot of natural enemies were observed in Turkey which are able to control almost all key pests, if the natural balance was not destroyed by the excessive use of pesticides. In this paper, we present the pest species and the natural enemies which were determined in Turkish olive growing areas from past till now.

Key words: Olive, Pests, Natural enemies, Turkey

INTRODUCTION

The olive (*Olea europea* L.) production includes about 129.265.000 trees enables producing 1.766.749 tons [1]. Turkey ranks fifth among the world olive grower countries (Tunusia (1.500.000 ha), Spain (1.199.090 ha), Italy (1.167.980 ha),) Greece (784.500 ha), Turkey (649.350 ha)), has the potential of exporting a great majority of its production of olive fruit. Olive growing areas in Turkey are located along the Aegean region (55.11%), the Marmara region (27.72%) and the Mediterranean region (14.94%) [2]. The olive growing areas have considerably increased within the last few years and further future expansion is expected.

Parallel to the significant increase of the olive growing areas, the pest and natural enemy populations have also been increased. Numerous surveys of olive orchards in Turkey revealed up to now 144 pest species. Among the species in olive orchards, 8 species are economically important pests have to be considered as key pests at different locations. In the present paper, olive pests determined in Turkish olive growing areas and their natural enemies which belong to 8 orders is being reported.

RESULTS

In Turkey, so far 144 pest species belonging to 49 families were determined by studies carried out in olive orchards [3-26]. All determined pests are presented in Table 1.

In total, 144 pest species belonging to different taxonomic groups, Homoptera (61), Coleoptara (39), Hemiptera (13), Lepidoptera (12), Diptera (5), Orthoptera (3), Aves(3), Thysanoptera (2), Acarina (2), Isoptera (2), Pulmonata (1) and Artiodactyla (1) were found. Among the pest species only 8 are of economic importance depending on regions (*Bactoracera oleae* Gmel., *Prays oleae* Bern, *Saissetia oleae* Olivier, *Parlatoria oleae* Colvèe, *Euphyllura olivina* Costa, *Calocoris trivialis* Costa, *C. annulus* Costa, *Pollinia pollini* Costa [7, 11, 27], while the others are considered as potential pests. At the same time however these pests have an abundant number of natural enemies.

Considerable research has been done over the past 50 years on the integrated pest management, yielding important advances for the olive industry in Turkey. So far to date, 102 natural enemies belonging to 8 orders and 31 families were determined [12, 13, 14, 28, 29,30, 31]. Table 2 shows the natural enemies determined in olive orchards in Turkey. As it is seen from Table 2 the natural enemies in olive orchards are belonging to orders Hymenoptera (49), Coleoptera (21), Hemiptera (15), Neuroptera (7), Acarina (4), Diptera (3), Tysanoptera (2) and Orthoptera (1). As it is shown from the table there are many natural enemies feeding on pests in olive.

In total, 8 pest species are of economic importance. *Bactrocera oleae* Gmel. (Dip.:Tephritidae) is the major

pest at all Turkish olive growing areas like other Mediterranean countries. In the orchards where the proper cultural practices are followed and harvest earlier, the damage is lower. *B. oleae* is associated with 11 different natural enemies (*Aprostocetus epicharmus* Walk. (Hym.: Chalcididae), *Cyrtoptyx dacicida* Masi. (Hym.: Pteromalidae), *Cyrtoptyx latipes* Rond. (Hym.: Pteromalidae), *Eurytoma parvula* Thom. *E. strigrifrons* Thom. *E. tibialis* Boh. (Hym.: Eurytomidae), *Eupelmus urozonus* Dalm. (Hym.: Eupelmidae), *Metaphycus silvestrii* Sug. (Hym.: Encyrtidae), *Opius concolor* Szelp. (Hym.: Braconidae), *Pnigalio mediterraneus* (Fer. and Del.) (Hym.: Eulophidae), *Zaglyptus multicolor* Grav. (Hym.: Ichneumonidae)) in Turkey. These natural enemies do not able to keep the pest population at low levels so especially at oil olive species, well-timed applications with non broad spectrum insecticides are recommended. If it is not controlled, it causes a damage of 15-30% which reaches up to 70% at the invasions. Insecticide applications for this pest are with either aerial or ground bait spraying and cover spraying method which is acceptable with integrated pest management (IPM) stategies. Mass trapping is an another control method at the orchards (min. 5 ha) where the pest population level is low. Furthermore, studies on using *O. concolor* as a biological control agent has been on going [32,33].

Twelve Lepidopterous pest species are known to occur in olive orchards in Turkey. Only one of them, *Prays oleae* is economically important especially at the isolated olive plantations and at some microclimates, at the orchards where intensive pesticide applications are done, and where the natural balance is destroyed [34]. The type of damage depends on the attacked tissue. The damage (leaf drop) done by the leaf or winter generation (phyllophagous) is seldom serious. On the contrary damage caused by the flower (anthophagous) generation can be important. These larvae directly destroy the flowers or cause the abortion of the flower bunches covered by silken threads spun by the larvae when passing from one bud to the next. The fruit (or carpophagous) generation larvae cause the premature drop of the fruits when they bore into the kernel of the olive fruit or later when they try to vacate the fruit to pupate. *P. olea* has various natural enemies (*Bracon variegator* Spinole. (Hym.:Braconidae), *Chelonus cingulipes* Niez. (Hym.:Braconidae), *Chelonella depressa* Thom., *Chelonus oculator* Panz., *Phanerotomella kerteszii* Szepl. (Hym.:Braconidae), *Aganiaspis fuscicollis praysincola* Silvestri (Hym.:Chalcididae), *Elasmus albipensis* Thom., *E. flabelletus* Fons. (Hym.:Elasmidae), *Oomyzus sempronius* Erd. (Hym.:Eulophidae), *Gelis areator* Panz. (Hym.:Ichneumonidae), *Lissonata proxima* Fons. (Hym.:Ichneumonidae) and predator is *Chrysoperla carnea* Steph. (Neur.: Chrysopidae)). These natural enemies does not keep the pest population below the economic thereshold. Sexual traps may help the control of the pest. The chemical control must be referred to apply only against the fruit generetion. Because the natural enemies are very active at the flower generation, insect growth regulators must be used if chemicel control is needed at this period [32, 35, 36].

Sixty two homopterous pest species have been determined in the olive orchards in Turkey, but only four of them (*Saissetia oleae, Parlatoria oleae, Euphyllura olivina, Pollinia pollini*) cause regularly damage to olive [32, 37, 38]. They have various natural enemies from both parasitoids and predators. *S. oleae* causes damages especially at Marmara region where Gemlik species is cultivated and at Bandırma and Erdek (Balıkesir) districts of Ege region which are close to Marmara region. It is also an important pest along the coastal zones of Balıkesir and Çanakkale where the ULV-bait spraying were applied from the middle of 1980's against *B. oleae*. At the other regions it is not an economically important pest. The natural enemy complex of *S. oleae* (*Chilocorus bipustulatus* L. (Col.: Coccinellidae), *Exochomus quadripustulatus* L. (Col.: Coccinellidae), *Symnus apetzi* Muls. (Col.: Coccinellidae), *Chrsoperla carnea* (Steph) (Neur.: Chrysopidae), *Scutellista cyanea* Motsch. (Hym.: Pteromalidae), *Metaphycus*

meteolus Timberlayt (Hym.: Encyrtidae), *M. lounsburgi* (Hym.: Encyrtidae)) is capable of keeping the pest under control, if no broad-spectrum insecticides are applied. Although enhancement and conservation remains the main important IPM strategies against *S. oleae,* summer oil applications are recommended where the parasitization rate is below 50% or population levels are high [39].

P. oleae, is an important pest of olive orchards where the effectiveness of parasitoids is reduced by the high dust impact. Because it lowers the pickled properties of the fruits, the damage of the second generation of the pest on the fruits is very important [40]. On the other hand, 13 species of parasitoids and predators are associated with *P. oleae*: (*Aphytis maculicornis* (Masi), *A. proclia* (Walker), *A. mytilaspidis* (Le Baron), *Aspidiophagus citrinus* (Hym.: Aphelinidae) and predators are *C. bipustulatus*, *E. quadripustulatus* (L.), *Cybocephalus fodori* (E.Y.) (Col.: Cybocephalidae), *S. apetzi*, *Lestodiplogis* sp. (Dip.: Cecidomyiidae), *Typhlodromus* sp., *Ambyliseius* sp. (Acarina: Phytoseiidae), *Allothrombium* sp. (Acarina: Trombidiidae), the most common ones being; *Aphytis* spp., *C. bipustulatus*. *E. quadripustulatus*. Besides protection and conservation of the natural enemy complex, cultural practices like irrigation, pruning, fertilization and keeping humidity low in orchards are the main control measures. Besides cultural practices specific insecticides are also recommended, in cases where *P. oleae* populations are high and the parasitization rate is below 50%.

The other pest species from Homoptera order is *E. olivina* with 13 natural enemies (*Aphytis* spp. (Hym.: Aphelinidae), *Psyllaephagus euphyllurae* Silv. (Hym.: Encyrtidae), *C. bipustulatus* L., *Pharoscymnus pharoides* Marsh. (Col.: Coccinellidae), *Cybocephalus fodori* minor (E.Y.) (Col.: Nitidulidae), *Anthocoris nemoralis* Fabr., *A. minki* Dohr. (Het.: Anthocoridae), *Orius niger* (Wolf), *Deraeocoris delagrrangei* Puton, *Heterotoma dalmatinum* Wgn., *Campyloneura virgula* H.S., *Myrmecoris gracilis* J. Sahlb., *M. coartatus* M-R (Het.: Miridae)) and *P. pollini*, *C. bipustulatus*, *E. quadrimaculatus*, *Chrysopa* sp. and *Cheletogenes ornatus*, have been determined for this pest in Turkish olive groves. [32, 41].

Calocoris spp. (*C. trivialis* and *C. annulus*) are the olive pests from Heteroptera [42]. It is the pest that directly causes damages at the flowers. *A. nemoralis* have been determined as the predator of the pest. This pest is seen at the Marmara, Ege and east Mediterranean region of Turkey. Olive has been determined as the main pest of the pest. The chemical control of the pest is nearby the olive moth flower generation control. At the orchards where the olive moth control is done, another insecticide application for *Calocoris* spp. is not needed.

CONCLUSION

Turkey has an important potential land aspects of olive production in the world. It has many olive pests changing in number not only year by year but also region by region. Turkish olive fauna is also very rich in its natural enemy complex.

Nowadays protection of humah health, environment and biological diversity emerge foreground. On account of the fact that struggling to pests, considering agroecosystem and sustainable agriculture, gets indespensable.

With enhancement and conservation of biological control agents, proper cultural practices and the application of specific insecticides, it is possible to sucessfully control the pests of olive in Turkey.

This paper submits all natural enemies and pests in olive orchards as a list taken from previous studies which are done by different researchers in Turkey. By this way this paper ensures to researchers jointly knowledge about olive pests and natural enemies for their future studies.

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Table 1. Olive pests determined in Turkey.

Order	Family	Species
Gastropoda		
Pulmonata	Helicidae	*Helix* sp.
Insecta		
Orthoptera	Gryllotalpidae	*Gryllotalpa gryllotalpa* L.
		Gryllotalpa vulgaris L.
	Tettigoniidae	*Poecilimon hamatus* Brunner
Thysanoptera	Phloeothripidae	*Liothrips oleae* Costa
	Thripidae	*Taeniothrips simplex* Morison
Hemiptera	Anthocoridae	*Anthocoris visci* Douglas
	Lygaeidae	*Paromius gracilis* Rb.
	Miridae	**Calocoris trivalis* Costa.
		**Calocoris annulus* Costa.
		Calocoris rubrinervis H.S.
		Lygus pratensis L.
		Psallus oleae Wgn.
		Adelphocoris vandalicus Rossi
		Stenodema virens L.
	Rhopalidae	*Stictopleurus pictus* Fab.
	Pentatomidae	*Raphigaster nebulosa* Poda
		Apodiphus amygdali Germar
		Nezara viridula Linneus
Homoptera	Aleyrodidae	*Aleurolobus olivinus* Silvestri
		Siphoninus phillyreae Haliday
		Aleyrodes olivinus Silv.
		Prociphilus oleae Koroneos
	Aphalaridae	*Euphyllura phillyreae* Foerst.
	Asterolecaniidae	**Pollinia pollini* Costa
	Cicadellidae	*Cicadella viridis* L.
		Selenocephalus Pallidius Kirsch.
		Synophropsis Lauri Horwath
		Megophthalmus scabripennis Edwards
		Asymetrasca decedens Paoli
		Edwardsiana rosae L.
		Eupteryx melissae Curtis
		Frutioidia bisignata Mulsant & Rey
		Empoasca decipiens Paoli
		Typhlocyba quercus Fabricius
		Zygina flammigera Fourcroy
		Zyginella pulchra Low
		Cicadulina bipunctella Matsumura
		Circulifer haematoceps Mulsant & Rey
		Fieberiella sp.
		Psammotetix striatus L.
	Cicadidae	*Cicadetta tibialis* Put.
		Cicadetta montana Scopoli
		Lyristes plebejus Scopoli
		Tibicina haematodes Scopoli
		Papiphora sp.
		Cicada orni L.
		Cicadae plebeja Scop.
		Cicadatra atra Oliv.
		Tettigia orni L.
	Pseudococcidae	*Planococcus citri* Rossi
	Coccidae	**Saissetia oleae* Olivier
		Filippia oleae Costa
		Filippia follicularis Targ.-Tozz.
		Saissetia hemisphaerica Targioni-Tozzetti
	Diaspididae	*Aonidiella aurantii* Maskell.
		Aonidiella citrina Coquillett
		**Parlatoria oleae* Colv.
		Quadraspidiotus ostreaeformis Curtis
		Leucaspis riccae Targ.-Tozz.
		Aspidiotus hederae Vall.

		Chrysomphalus dictyospermi Morgan
		Chrysomphalus aonidum Linnaeus
		Leucaspis pini Hart
		Parlatoria judaica Bodenheimer
		Aspidiotus britannicus Newst.
		Aspidiotus nerii Bouché
		Cornuaspis beckii New.
		Dynaspidiotus britannicus News.
		Epidiaspis leperii Sig.
		Filippia oleae Costa
		Hemiberlesia lataniae S.
	Fulgoridae	*Hysteropterum grylloides* F.
	Issidae	*Agalmatium bilobum* Fieb.
		Agalmatium flavescens Oliv.
		Kovacsiana antalyica Dlab.
	Margarodidae	*Monophlebus serratula* F.
		Gueriniella serratulae F.
	Pemphigidae	*Prociphilis oleae* Koroneos
	Psyllidae	**Euphyllura olivina* Costa.
Coleoptera	Alleculidae	*Omophlus* spp.
		Omophlus caucasicus Kirsch.
		Omophlus flavipennis Küst.
		Omophlus dilatatus Fald.
	Attelabidae	**Coenorrhinus cribripennis* Desb.
	Bostrychidae	*Apate monachus* F.
		Sinoxylon sexdentatum Oliv.
	Buprestidae	*Capnodis tenebrionis* L.
		Capnodis carbonaria Klug.
	Cerambycidae	*Cerambyx dux* Fald.
	Curculionidae	*Ottiorrhynchus europaeus* Stierl.
		Otiorhynchus anatolicus Boheman
		Rhynchites cribripennis Desbr.
		Rhynchites ruber F.
		Ottiorrhynchus clavipes Bousd.
		Ottiorrhynchus cribricollis Gyll.
		Ottiorrhynchus lubriculus Faust.
		Stereonychus fraxini De Geer
		Ottiorrhynchus aurifer Boh.
		Ottiorrhynchus lugdunensis Boh.
		Ottiorrhynchus sabulosus Gyll.
		Ottiorrhynchus sulcatus F.
		Ottiorrhynchus meridionalis Gyll.
		Ottiorrhynchus gracilicornis Stierl.
		Cionus fraxini Deg.
	Scarabaeoidae	*Polyphylla fullo* L.
		Oxythrea cinctella Schaum
		Polyphylla spp.
		Oryctes nasicornis L.
	Scolytidae	*Phloeotribus scarabeoides* Bern
		Hylesinus oleiperda Fabr.
		Hylesinus fraxini Panz.
		Hylesinus vestitus Rey.
		Phloeotribus oleae F.
		Leperesinus fraxini Panz.
		Phloeopthorus brevicollis Kol
		Phloeotribus scarabaeoides Bern.
	Tenebrionidae	*Opatrioides punctulatus* Brulle
		Laena pulchella Fischer de Waldheim
Lepidoptera	Arctiidae	*Hyphandria cunea* Drury
	Cossidae	*Zeuzera pyrina* L.
		Cossus cossus L.

	Gelechidae	*Oecophora oliviella* F.
	Geometridae	*Boarmia umbraria* Hb.
		Problepsis ocellata Friv
	Gracilariidae	*Parectopa latifoliella* Mill.
	Hyponomeutidae	**Prays oleae* Bern.
	Oecophoridae	*Oecophyllembius latifoliellus* Mill.
		Oecophyllembius neglatus Silvestri
	Pyralidae	*Margaronia unionalis* Hübn.
		Glyphodes unionalis Hb.
Diptera	Cecidomyiidae	*Perrisia oleae* Loew.
		Clinodiplosis oleisuga Targ.
		Lasioptera berlesiana Paoli
		Cecidomyia oleae Loew
	Tephritidae	**Bactrocera oleae* Gmel.
Isoptera	Kalotermitidae	*Kalotermes flavicollis* F.
	Rhinotermitidae	*Reticulitermes lucifugus* Rossi
Arachnida		
Acarina	Eriophyidae	*Aceria oleae* Nal.
	Tenuipalpidae	*Brevipalpus olearius* Sayed
Aves	Columbidae	*Columba livia* L.
	Sturnidae	*Strunus vulgaris* L.
		Pastor roseus L.
Mammalia		
Artiodactyla	Suidae	*Sus sesofa* L.

*Important pests.

Table 2. Natural enemies determined in olive orchards in Turkey.

Order	Family	Species
Insecta		
Ortoptera	Mantidae	*Mantis religiosa* L.
Thysenoptera	Aelothripidae	*Aelothrips collaris* Priesner
		Aelothrips gloriosus Bagnall
Hemiptera	Anthocoridae	*Anthocoris nemoralis* Fabr.
		Anthocoris minki Dohr.
		Dufouriellus ater Duf.
		Orius minitus L.
		Orius niger Wolff
		Orius horvathi Reut.
	Miridae	*Campyloneura virgula* H.S.
		Deraeocoris delagrrangei Puton
		Heterotoma dalmatinum Wgn.
		Myrmecoris coartatus M-R.
		Myrmecoris gracilis J. Sahlb.
		Pilophorus Pusillus Reut.
	Reduviidae	*Nagusta goedeli* Klt.
		Empicoris mediterraneus Hob.
	Scelionidae	*Telenomus* spp.
Neuroptera	Chysopidae	*Anisochrysa genei* Ramb.
		Anisochrysa zelleri Scheneider
		Chrysoperla carnea Steph.
		Chrysopa sp.
		Suairus nanus Mclachlan
	Coniopterygidae	*Conwentzia hageni* Banks.
	Raphididae	*Raphidia ressli* Asp.et.Asp.
Coleoptera	Cleridae	*Denops albofasciatus* Charp.
		Opilo taeniatus Kolenati
	Cybocephalidae	*Cybocephalus fodori minor* E.-Y.
	Coccinellidae	*Chilocorus bipustulatus* L.
		Coccinella septempunctata L.
		Exochomus quadrimaculatus L.
		Nephus quadrimaculatus Herbst
		Pharoscymnus pharoides Mars.
		Scymnus apetzi Muls.
		Scymnus quadrimaculatus Charp.
		Scymnus apetzoides Muls.
		Scymnus bipunctatus Kug.
		Scymnus pallidiventris Muls.
		Scymnus pallipediformis Günther
		Scymnus inderihensis Mulsant
		Scymnus interruptus Go.
		Scymnus rubromaculatus Go.
		Stethorus punctilum Weise
	Nitidulidae	*Cybocephalus fodori* E.-Y.
	Ostimidae	*Nemosoma elogatum* l.
Hymenoptera	Aphelinidae	*Aphytis maculicornis* Masi
		Aphytis proclia Walker
		Aphytis mytilaspidis Le Baron
		Aspidiophagus citrunus Grav.
	Braconidae	*Bracon variegator* Spinole
		Chelonus cingulipes Niez.
		Chelonus oculator Panz.
		Phanerotoma sp.
		Phanerotomella kerteszii Szepl.
		Chelonella depressa Thoms.
		**Opius concolor* Szelp.
		Dendrosotinus ferrigineus Marshall.
		Ecphylus sp.
	Chalcididae	*Aprostocetus epicharmus* Walk.

		Aganiaspis fuscicollis praysincola Silv.
	Elasmidae	*Elasmus albipennis* Thom.
		Elasmus flabellatus Fons.
	Encyrtidae	*Psyllaephagus euphyllurae* Silv.
		Metaphycus silvestrii Sug.
		Ageniaspis fuscicollis Dalm.
		Microterys masii Silv.
		Metaphycus. Lounsburgi How.
	Eulophidae	*Pediopius* sp.
		Tetrastichus sp.
		Elachertus sp.
		Pnigalio soemius Walk.
		Pnigalio mediterraneus Ferr. and Del.
		Oomyzus sempronius Erd.
	Eupelmidae	*Eupelmus urozonus* Dalm.
	Eurytomidae	*Eurytoma morio* Boh.
		Eurytoma parvulo Thom.
		Eurytoma strigrifrons Thom.
		Eurytoma tibialis Boh.
	Ichneumonidae	*Exochus* sp.
		Zaglyptus multicolor Grav.
		Gelis areator Panz.
		Lissonata proxima Fons.
	Platygasteridae	*Platygaster* sp.
	Pteromalidae	*Cheirophacus quadrum* F.
		Metacolus unifasciatus Först.
		Cerocephala eccoptogastri Först.
		Heydenia pretiosa Först.
		Rhaphigaster maculatus Först
		Rhaphitelus maculatus Walk.
		Scutellista cyanea Motsch.
		Mesopolobus mediterraneus Mayr.
		Cyrtoptyx dacicida Masi
		Cyrtoptyx latipes Rond.
	Scelionidae	*Telenomus* spp.
Diptera	Asilidae	*Asilus* sp.
	Cecidomyiidae	*Lestodiplogis* sp.
		Prolesioptera berlesiana Paolin
Arachnida		
Acarina	Cheyletidae	*Cheletogenes ornatus* Can. and Fan.
	Phytoseiidae	*Ambyliseius* sp.
		Typhlodromus sp.
	Trombidiidae	*Allothrombium* sp.