

## Monitoring Pests of Winter Cultivated Canola in Aydin, Turkey

<sup>1</sup>Ibrahim Gencsoylu and <sup>2</sup>Onder Akpinar

<sup>1</sup>Department of Plant Protection, Faculty of Agriculture,  
Adnan Menderes University, Protection, AYDIN, Turkey

<sup>2</sup>TARIS (Fig, Raisin, Cotton and Oil Seeds Agricultural Sales Cooperatives),  
Liman Caddesi No: 10 35230 Alsancak / Izmir, Turkey

**Abstract:** The study was conducted to determine insects of winter cultivated canola in Aydin province, Turkey. The Sary cultivar was used in the study. The sampling was recorded at weekly intervals from 15 canola plants randomly selected from the canola field. From each plant the leaf, inflorescence and pod were checked. At the harvest 10 canola plants were cut from the soil surface and examined visually for other pests that might be living within the stalk. The study showed that *Brevicoryne brassicae* (L.), *Thrips tabaci* Lind., *Frankliniella occidentalis* (Pergande), *Chromatomyia horticola* (Goureau), *Epicometis hirta* (Poda), *Pieris brassicae* (L.), *Eurydema ornatum* (L.), *Meligethes* spp., *Scaptomyza flava* Fallen and *Phyllotreta* spp. were recorded in the canola field. *B. brassicae*, *S. flava*, *C. horticola* and *Thrips* spp. should be major insects of the canola in Aydin province while the other pests are minor pests. The study will be helpful for the management program in the winter canola in Turkey.

**Key words:** Canola · Pest · Winter cultivar

### INTRODUCTION

Canola is a type of edible oil that was developed in Canada through plant breeding. It is low in erucic acid and glucosinolate, making it suitable for human consumption and contains about 40% oil. Canola oil is healthier due to its low to zero saturated fat, high monounsaturated oil content and beneficial omega-3 fatty acids. It also makes good feedstock for the biodiesel and biolubricant industry. However, generic rapeseed oil is not edible and used only as a machine lubricant or for diesel-like fuel [1].

Total cultivated area in Turkey is very low with 700 ha in 2005 and it has been rapidly increased and reached 28,100 ha with 83,965 tonnes production in 2008 [2].

Generally, a diverse group of insect species is associated with canola in the USA, Europe, Asia and Australia. However, severity of infestations by major pest species is variable worldwide. At least 30 species have been identified on canola [3,4]. Lamb [5] reported that twenty-one insect pests feed on canola worldwide and the plant has a great tolerance and recovery from the herbivorous damage and only a few species are regarded as major pests [6]. The major insect pests of canola are

*Ceutorhynchus assimilis* (Paykull), *C. napi*, *C. neglectus*, *C. quadridens*, *Mamestra configurata* Walker, *Phyllotreta cruciferae* Goeze, *P. striolata*, *P. atra*, *Lygus lineolaris* (Palisot de Beavois), *Plutella xylostella* (Linnaeus), *Meligethes aeneus* (F.), *Psylloides chrysocephala* L., *Athalia rosae* L., *Brevicoryne brassicae* (Linnaeus), *Hyadaphis erysimi* (Kaltenbach), *Scaptomyza flava* Fallen and *Delia* spp [7-16].

In Turkey more studies were conducted mainly on sowing date, fertilization, yield and yield component [17-20] and a study was obtained about pests of canola in the country. Demirel [21] determined that he found twenty-one (21) species belonging to Miridae, Pentatomidae, Lygaeidae, Rhopalidae and Scutelleridae families in Heteroptera species in Hatay province of Turkey. Other than this study no research was found on the pest of canola. The aim of this study was to determine pest species in winter cultivated canola field.

### MATERIALS AND METHODS

The experiment was conducted at the Agricultural Research Center of Adnan Menderes University, Aydin province. The Sary canola cultivar was planted on

27 October 2008. Seed rate was 410 gr/da. The row to row distance was 26 cm. All cultural practices including fertilization and cultivation practices were conducted. Before planting herbicide Azotraks as trade name was applied into the experimental field. The experiment was harvested on 27 May 2009.

Sampling of pests was initiated on 20 November 2008 and continued up to 27 May 2009. The sampling was recorded at weekly intervals from 15 canola plants randomly selected from the canola field. From each plant a leaf, inflorescence and pod was checked. At the harvest 10 canola plants were cut from the soil surface and examined visually for other pests that might be living within the stalk.

For the sucking pests Aphids and thrips species were kept in vials containing 70% alcohol and returned to the laboratory for processing. For the leaf miners species *Chromatomyia horticola* (Gourea) and *S. flava* the leaves infested with both miners were kept in a plastic container at 25±1°C and 65% relative humidity for 3-4 weeks to allow adults to emerge. A sheet of absorbent paper was placed between all the leaves in the plastic container to prevent contact and the possibility of mold growing in the humid conditions and adult flies and the other adult species collected from the field were killed, pinned and sent to specialist for identification. The immature larvae or nymphs including lepidopteran larvae and other orders were reared in the laboratory by adult stage at the same laboratory conditions.

## RESULTS AND DISCUSSION

The study showed that *B. brassicae*, *Thrips tabaci* Lind., *Frankliniella occidentalis* (Pergande), *C. horticola*, *Epicometis hirta* (Poda), *P. brassicae*, *Eurydema ornatum* (L.), *Meligethes* spp., *S. flava* and *Phyllotreta* spp. were identified in canola field of Aydın.

During the study, *B. brassicae*, *S. flava*, *Thrips* spp. and *C. horticola* should be major insects of the canola in Aydın province. However, *E. hirta*, *P. brassicae*, *E. ornatum* and *Meligethes* spp. should be minor pests. Table 1 showed that *B. brassicae*, *T. tabaci*, *F. occidentalis*, *C. horticola* and *Phyllotreta* spp. at the vegetative stage, *B. brassicae*, *C. horticola*, *E. hirta*, *Meligethes* spp. and *S. flava* at flowering stage, *B. brassicae*, *C. horticola*, *P. brassicae*, *E. ornatum* and *S. flava* at podding stage were observed during the study.

The data showed that the aphid *B. brassicae* has been showed during the all periods including vegetative, flower and pod stage. The species was observed at the first sampling week and reached to the highest level with 51, 20, 19 aphids per 15 plants on 18 December 2008, 18 March 2009 and 2 May 2009. The population was found on the leaves at the vegetative stage and inflorescence in March and also the base of pod in May (Table 3). The population was the lower compared with the other studies. Aslam *et al.* [22] studied on the population of *B. brassicae* and he found that the mean number of the population on the inflorescence was between 57.8-30.7 depending on the varieties. Sarwar *et al.* [23] also reported that the population amount of *B. brassicae* fluctuated accordingly from 47.79 to 93.67 and 28.27 to 184.5 aphids during the years 2001 and 2002. The reason for the lower population in the experiment should be due to the environmental conditions. The rainfall 779.8 mm during the experimental period was higher compared with the previous year (Table 2). Mostly the population should be affected from the the rainfall. Kelm and Klukowski [24] mentioned that *B. brassicae* populations are most numerous in March and the increase in rainfall during the early spring caused a high reduction in the population which wintered in oilseed rape.

During the study the aphid species was *B. brassicae*. There are not any species recorded. However, *B. brassicae*, *Lipaphis erysimi* Kalt and *Myzus persicae* (Sulzer) are the major aphid pests infesting canola [25]. Hamid and Ahmad [26] mentioned that winter oilseed *Brassica* crops are attacked by *L. erysimi* and followed by *B. brassicae* and *M. persicae*. Also *Aphis craccivora* Koch also found on the canola field in Australia [27] and Pakistan [28]. Aphids are one of the important reasons for yield loss in this crop [29]. Miles and McDonald [6] mentioned that *L. erysimi* is the most abundant species in canola at flowering and podding. The other two aphid species occur less frequently and rarely persist in large number on flowering plant. Rehman *et al.* [25] *B. brassicae* is the most destructive pests. It forms large colonies on leaves, stems and inflorescence, cause severe damage and reduce seed yield loss of 9-77%. Aphids also cause an 11% reduction in seed oil content [30]. Rustamani *et al.* [31] reported that aphid population increases rapidly in canola fields and causes 70-80% yield reduction in Sindh province. In addition to the damage, it is also important for a vector of various disease.

Table 1: Insects of canola at different stages

Insects	Stages		
	Vegetative	Flower	Pod
<i>Brevicoryne brassicae</i>	+	+	+
<i>Thrips tabaci</i>	+		
<i>Frankliniella occidentalis</i>	+		
<i>Chromatomyia horticola</i>	+	+	+
<i>Epicometis hirta</i>		+	
<i>Pieris brassicae</i>			+
<i>Eurydoma ornatum</i>			+
<i>Meligethes</i> spp.		+	
<i>Scaptomyza flava</i>		+	+
<i>Phyllotreta</i> spp.	+		

+: The insect was found at this stage

Table 2: Meteorological data during the years 2008-2009

Month/Year	Cumulative rainfall (mm)	Temperature (°C)	Relative Humidity (%)
2008-2009			
October	27.0	18.6	57.2
November	75.0	14.5	71.5
December	95.6	10.2	70.3
January	267.4	9.2	78.4
February	160.8	9.4	77.0
March	87.6	11.3	65.7
April	67.2	16.1	67.6
May	19.2	21.3	49.4

Table 3: Total amount of the populations per 15 plants during the 2008-2009

Sampling date	<i>Brevicoryne brassicae</i>	<i>Thrips</i> spp.	<i>Chromatomyia horticola</i>	<i>Epicometis hirta</i>	<i>Scaptomyza flava</i>
20.11.2008	3	0	0		
27.11.2008	1	0	0		
04.12.2008	8	3	0		
18.12.2008	51	7	1		
23.12.2008	7	1	0		
02.01.2009	24	1	1		
09.01.2009	12	0	0		
16.01.2009	0		0		
22.01.2009	2		1		
29.01.2009	0		0		
04.02.2009	0		0		
11.02.2009	0		1		
17.02.2009	0		0		
25.02.2009	0		0		
03.03.2009	0		0		
11.03.2009	0		0		
18.03.2009	20		0		
25.03.2009	0		0		
02.04.2009	0		1		
08.04.2009	5		1	0	0
17.04.2009	7		2	3	7
20.04.2009	1		2	1	21
02.05.2009	19		0	0	3
08.05.2009	0		0	1	0
15.05.2009	0		0	2	0
22.05.2009	0		0	0	0
27.05.2009	0		0	0	0

In the study two thrips species were recorded as *T. tabaci* and *F. occidentalis*. The data were recorded together and given *Thrips* spp. in the Table 3. The population was observed on the leaves at the vegetative stage after third sampling week and higher on 18 December 2008 with 7 adults and not observed after 2 January 2009 (Table 3). It seems to be not harmful insect in the region. On the other hand, Cranshaw [32], Kirk and Terry [33], Demirel and Cranshaw [34] reported that the two thrips species are the most common pests on the canola plant in Colorado. Besides the two thrips species *Thrips imagins* Bagnall [3], *F. tritici*, *F. fusca* and *Neohydatothrips variabilis* Beach [8] were observed in canola fields. Thrips species are attacking leaves, inflorescence and buds during the feeding stage and cause significant damage on canola [35]. In the study it is not found at inflorescence. The reason should be rainfall during the periods.

Infestation with the leafminer *C. horticola* was firstly recorded on 18 December 2008 at the vegetative stage and observed throughout all seasons by 20 April 2009 with low amount. The infestation was not observed after this time due to dropping the leaves on the lower part of the plant (Table 3). The pest is widely distributed in the mediterranean area, Europe and Asia [36]. It is polypagous pest that feed on 34 family plants including vegetables, ornamental plants and weeds and first found in 1958 on chrysanthemum in Turkey [37,38]. However, the species is not recorded in canola field of Turkey. With the study *C. horticola* was the first time recorded on the leaves of canola. In worldwide *C. horticola* was only mentioned by Saljoqi *et al.* [10] in Peshawar, Pakistan. They reported that it attack in last week of February and continued up to 2<sup>nd</sup> week of April 1999. Other than *C. horticola* a leafminer *Phytomyza rufipes* Meigen was recorded by Scheffer and Winkler [39] and it is a leafmining pest of Brassicaceae in Europe and other regions of the world.

The species *E. hirta* was recorded during the flowering stage, not other stages. It appeared on 17 April 2009 with 3 adults per inflorescence and not observed after 15 May 2009 (Table 3). The first time it was recorded in canola field of Turkey and not observed in other countries. However, it was observed in many crops. The species is widespread in large parts of Eurasia, from the Mediterranean to the Middle East and Central Asia [40]. It damages the reproductive parts of flowers of several orchard trees and many ornamental bushes [40,41] and secondary pest in sweet cherry (*Prunus avium* L.) orchards [42] and the most destructive in oil bearing rose in Bulgaria [43].

In the experiment *S. flava* from Drsophilidae family was recorded as another leafminer. It was recorded during the late period of flower and pod stage. It appeared on 17 April 2009 with 7 infested leaves and reached to the highest level with 21 numbers on 20 April 2009 and it was not observed after 2 May 2009 (Table 3). The species was first time recorded in canola field. *C. horticola* and *S. flava* had been observed at the same period, mainly late stage of canola. It occurs as a pest in temperate and tropic zones. *S. flava* is widespread in Europe, Asia, North America, Australia. This polyphagous species has been recorded from 10 families of plants [44,45], but is principally found on Brassica crops and caused commercial losses [16] and rarely a problem on European vegetable brassicas, such as cabbage, broccoli and cauliflower, but is readily found in unsprayed Asian brassicas, such as Chinese cabbage (*Brassica campestris* spp. *pekinensis*).

In addition to all pests introduced above, *Meligethes* spp. *E. ornatum* and *P. brassicae* were recorded during the study. *Meligethes* spp. was observed at flower stage on 3, 11 March and 8 May 2009 with 3, 2 and 4 adults per inflorescence (not given in Table 3). Some researchers reported that *Meligethes aeneus* was the most abundant pest in a spring and winter oilseed rape crop in Denmark [46], Estonia [47], Croatia [48]. Kelm and Klukowski [24] mentioned that *Meligethes* spp. on the yield occurred only when the rainfall in July was reduced to 1/3 of the average and mentioned that they were by far the most common and numerous pests at all sites.

*E. ornatum* was observed on 22 May 2009 with 2 adults. It seems not to be harmful and should be minor insect of canola (not given in Table 3). In worldwide studies *E. ornatum* is distributed over large parts of the Palearctic Region, especially Europe and the Mediterranean countries [49,50,51]. Önder *et al.* [52] mentioned that 188 species from Pentatomidae family were found on some plants in the country. However, he did not report the species in canola field. The species was observed in canola field of Hatay province by Demirel [21].

The species *P. brassicae* was observed on 20 April 2009 on leaves at pod stage of canola with 10 larvae (not given in Table 3). The young caterpillars feed gregariously on leaves and pods defoliating the plants [53,54]. A research is available on the pest in canola field. Saljoqi *et al.* [10] reported that *P. brassicae* is pest of canola and the species was observed from 2<sup>nd</sup> week of February till 10<sup>th</sup> of April 1999 in Pakistan. The population appeared at different periods due to environmental

conditions. It is a serious pest of cabbage, cauliflowers and many crucifers found along temperate, tropical and subtropical regions of the world [55].

The species *Phyllotreta* spp. was also recorded. However, the population and ratio of damage to the leaves was not recorded due to sampling time. The sampling was initiated on 20 November 2008. The pest was mainly found before the first sampling date. During the experiment no insect was found on the root and stalk during the experiment.

#### ACKNOWLEDGMENT

Thanks to Drs. Irfan Tunc, Gerhard Baechli, Hasan Sungur Civelek and Isıl Özdemir for the identification of the pest species. We also thank to TARIS for its support.

#### REFERENCES

1. Raymer, P.L., 2002. Canola an emerging oilseed crop. In: Trends in new crops and new uses (eds J. Janick and A. Whipkey), ASHA Press, Alexandria, USA., pp: 122-126.
2. Anonymous, 2008. Statistical divisions of Agricultural Department of Aydin province, Turkey.
3. Stanley, M. and S. Marcroft, 1999. Canola: The ute guide. TOPCROP Australia, Primary Industry and Resources South Australia, Adelaide, Australia.
4. Micic S., 2005. Identification and cultural control of insect and applied pests of canola. Bulletin 4650. Department of Agriculture, SouthPerth, Western Australia, Australia.
5. Lamb, R.J., 1989. Entomology of oilseed crops. Ann. Rev. Entomol., 34: 211-33.
6. Miles, M. and G. McDonald, 1999. Insect pests of canola. In: Canola in Australia-the First Thirty Years (eds: P.A. Salisbury, T.D. Potter, G. McDonald and A.G. Green), pp: 53-58. The Canola Association of Australia Inc, Young, New South Wales, Australia.
7. Dossall, L.M., M.A. McFarlane and P. Palaniswamy, 1999. Biology and larval morphology of *Ceutorhynchus neglectus* (Coleoptera: Curculionidae), a minor pest of canola (*Brassicaceae*) in western Canada. Canadian Entomologist, 131(2): 231-242.
8. Boyd, M.L. and G.L. Lentz, 1999. Seasonal occurrence and abundance of the tarnished plant bug (Hemiptera: Miridae) and *Thrips* (Thysanoptera: Thripidae) on rapeseed in West Tennessee. J. Agricultural and Urban Entomol., 16(3): 171-178.

9. Ramachandran, S., G.D. Buntin and J.N. All, 2000. Response of canola to simulated diamondback moth (Lepidoptera: Plutellidae) defoliation at different growth stages. Canadian J. Plant Sci., 80(3): 639-646.
10. Saljoqi, A.U.R., S. Rehman, N. Hussain and S.A. Khan, 2006. Insect pest of canola crop (other than aphid). J. Agricultural and Biological Sci., 1(4): 19-21.
11. Sekulic, R. and T. Keresi, 2007. Use of Yellow Traps in Rapeseed Protection Against Pests. Biljni, 35(1): 18-24.
12. Valantin, M.M., J.M. Meynard and T. Dore, 2007. Effect of crop management and surrounding field environment on insect incidence in organic winter oilseed rape (*Brassica napus* L.). Crop Protection, 26(8): 1108-1120.
13. Mrowczynski, M., H. Wachowiak, G. Pruszyński, C. Musnicki, W. Cieslicki and S. Heimann, 2007. Damage of registered Polish winter oilseed rape cultivars caused by pests. Progress in Plant Protection, 47(1): 331-335.
14. Carcamo, H.A., J.K. Otani, L.M. Dosball, R.E. Blacshaw, G.W. Clayton, K.N. Harker, J.T. O'Donovan and T. Entz, 2008. Effect of seeding date and canola species on seedling damage by flea beetles in three ecoregions. J. Applied Entomol., 132(8): 623-631.
15. Zaller, G.J., D. Moser and T. Drapela, 2009. Ground-dwelling predators can affect within-field pest insect emergence in winter oilseed rape fields. Biocontrol., 54: 247-253.
16. Martin, N. and F. MacDonald, 2009. Evaluating the impact of insecticides on *Scaptomyza flava* and its parasitoid, *Asobara persimilis*. New Zealand J. Crop and Horticulture Sci., 37(3): 243-252.
17. Ozer, H. and E. Oral, 1999. Relationships between yield and yield components on currently improved spring rapeseed cultivars. Turkish J. Agriculture and Forestry, 23: 603-607.
18. Ozer, H., 2003. Sowing date and nitrogen rate effects on growth, yield and yield components of two summer rapeseed cultivars. Europ. J. Agronomy, 19: 453-463.
19. Gizlenci, S., M. Dok and M. Acar, 2005. Orta Karadeniz sahil kusaginda kolza için en uygun sıra araliginin belirlenmesi. Hasat Der., 244: 88-94. (Turkish with english abstract).
20. Celik, H. and M.A. Kaynak, 2007. Kolza (*Brassica napus ssp. oleifera* L.) çeşitlerinde ekim zamanlarının verim ve verim unsurları üzerine etkisi. (The effect of different sowing date on the yield and yield components in rapeseed varieties (*Brassica napus ssp. oleifera* L.). Master Tezi, Adnan Menderes Üniversitesi, Fen Bilimleri Enstitüsü, AYDIN (Turkish, with English Summary).
21. Demirel, N., 2009. Determination of Heteroptera species on canola plants in Hatay province of Turkey. African J. Agricultural Res., 4(11): 1226-1233.
22. Aslam, M., M. Razaq and A. Shahzad, 2005. Comparison of different canola (*Brassica napus* L.) varieties for resistance against cabbage aphid (*Brevicoryne brassicae* L.). International J. Agriculture and Biol., 7(5): 781-782.
23. Sarwar, M., N. Ahmaad, Q.H. Siddiqui, A. Ali and M. Tofique, 2004. Genotypic response in canola (*Brassica* species) against aphid (Aphidae: Homoptera) attack. The Nucleus, 41(1-4): 87-92.
24. Kelm, M. and Z. Klukowski, 2000. Weather as a factor determining damage caused by oilseed rape pests. Bulletin OILB/SROP, 23(6): 119-124.
25. Rehman, K.A., M. Munir and A. Yousaf, 1987. Rape and mustard in Pakistan. PARC, Islamabad.
26. Hamid, S. and S. Ahmad, 1980. Biological assessment of three different insecticides sprayed against *Lipaphis erysimi* (Kaltenbach) on Winter Oilseed Crops. Proc. Pak. Congr. Zool., 30<sup>th</sup> April-1<sup>st</sup> May 1980, pp: 283-290.
27. Gu, H., G.P. Fitt and G.H. Baker, 2007. Invertebrate pests of canola and their management in Australia: A review. Australian J. Entomol., 46: 231-243.
28. Asfaq, M., M. Hassan, B. Salman, W. Salman and N. Rana, 2007. Some studies on the efficiency of *Chrysoperla carnea* against aphid, *Brevicoryne Brassicae*, Infesting Canola. Pak. Entomol., 29(1): 37-41.
29. Khattak, S.U. and M. Ahmad, 1993. Effect of different dates of sowing on rapeseed aphid (*B. brassicae*) infestation. Proc. Pakistan Cong. Zool., 13: 249-254.
30. Kelm, M. and H. Gadomski, 1995. Occurrence and harmfulness of the cabbage aphid (*Brevicoryne brassicae* L.) on winter rape. Materially Sesji Instytutu Ochrony Roslin, 35: 101-103.
31. Rustamani, M.A., U.F. Qaimbkhani and G.H. Munshi, 1998. Efficacy of Different Insecticides Against Mustard Aphid. Sarhad J. Agric., 4: 659-664.

32. Cranshaw, W., 1998. Pests of the west revised prevention and control for today's garden and small farm. Fulcrum publishing. Golden, Colorado, pp: 248.
33. Kirk, W.D.J. and L.I. Terry, 2003. The spread of the western flower thrips *Frankliniella occidentalis* (Pergande). Agric. For. Entomol., 5: 301-310.
34. Demirel, N. and W. Cranshaw, 2005. Attraction of color traps to *Thrips* species (Thysanoptera: Thripidae) on *Brassica* crops in Colorado. Pakistan J. Biological Sci., 8(9): 1247-1249.
35. Burgess, L. and H.H. Weegar, 1988. Thrips (Thysanoptera) in canola crops in Saskatchewan. Can. Entomol., 120: 815-819.
36. Spencer, K.A., 1973. Agromyzidae (Diptera) of economic importance. Series Entomologica, Vol. 9 Kluwer, Dordrecht, pp: 418.
37. Kaya, N. and P. Hincal, 1991. Survey studies on *Liriomyza trifolii* (Burgess ) and *Phytomyza horticola* Goureau (Diptera: Agromyzidae) which found on leguminous plants in Aegean Region. Turk. J. Entomol., 15: 241-246.
38. Cikman, E. and N. Uygun, 2003. Sanliurfa ilinde tarım ve tarım disi alanlarda saptanan galerisinegi (Diptera: Agromyzidae) türleri ve parazitöitleri (The determination of leafminers (Diptera: Agromyzidae) and their parasitoids in cultivated and non-cultivated areas in Sanliurfa province, southern Turkey). Türkiye Entomoloji Dergisi, 27(4): 305-318. (Turkish with English Summary).
39. Scheffer, S. and I. Winkler, 2008. The first confirmed record of the leafminer *Phytomyza rufipes* (Diptera: Agromyzidae) in the United States. Proceedings of the Entomological Society of Washington, 110: 674-678.
40. Hurpin B., 1962. Super-Famille des Scarabaeoidea. In: Entomologie appliquee a l'agriculture (A.S. Balachowsk., eds.). Masson et Cie Editerurs, Paris, pp: 24-204.
41. Homonnay, F. and E. Homonnayne-Csehi, 1990. Cserebogarak D Melolonthidae. In: A növényvedelmi a llat-tan kezikönyve III/A (T. Jerny and K. Bala, eds.). Akademiai Kiado, Budapest, pp: 156-215.
42. Cetin, G., C. Hantas, S. Soyergin and M. Burak, 2008. Studies on integrated pest management (IPM) in sweet cherry orchards in the Marmara Region of Turkey. Eds: M. Burak, G.A. Lang, H. Gulen, A. Ipek. Book Authors: A. Eris. Proceedings of the V<sup>th</sup> international cherry symposium, Vols 1 and 2 , Acta Horticulturae, 795: 925-931.
43. Margina, A., I. Lecheva, L.E. Craker and V.D. Zheljzkov, 1999. Diseases and pests on Bulgarian oil-bearing rose (*Rosa kasanlika* VT = *Rosa damascena* Mill. var. *kasanlika*). wocmap-2: Second world congress on medicinal and aromatic plants for human welfare, proceedings agricultural production post-harvest techniques biotechnology, Acta Horticulturae, 502: 237-241.
44. Maca, J., 1972. Czechoslovak species of the genus *Scaptomyza* Hardy (Diptera, Drosophilidae) and Their Bionomics. Acta Entomologica Bohemoslov, 69: 119-132.
45. Martin, N.A., 2004. History of an invader, *Scaptomyza flava* (Fallen, 1823) (Diptera: Drosophilidae). New Zealand J. Zool., 31(1): 27-32.
46. Hansen, L.M., 2003. Pests in oilseed rape crops. DJF raport, Markbrug, 89: 151-152.
47. Veromann, E., A. Luik, L. Metspalu and I. Williams, 2006. Key pests and their parasitoids on spring and winter oilseed rape in Estonia. Entomologica Fennica, 17(4): 400-404.
48. Jelovcan, S.T., C. Gotlin and H. Sambolek, 2007. Monitoring spring pests of oilseed rape. Glasilo Biljine Zastite, 7(6): 375-379.
49. Aukema, B., 1993. *Rhopalus tigrinus* (Rhopalidae) and *Eurydema ornatum* (Pentatomidae) new for the Dutch fauna (Heteroptera). Entomol.Ber (Amst.) 53(2): 19-22 (Dutch, with English summary).
50. Lodos, N., 1982. Türkiye Entomolojisi II (Genel, Uygulamali Faunistik). Ege Universitesi Matbaasi, Bornova, Izmir, Türkiye.
51. Rosca, I. and C. Popov, 1982. Heteroptera of Romania-zoogeographic characterisation and economic importance. Probl. Prot. Plant., 10(2): 123-160. (Romanian, with English summary).
52. Önder F, Y. Karsavuran, S. Tezcan and M. Fent, 2006. Türkiye Heteroptera insecta katalogu. Meta Basim Matbaacilik Hizmetleri. Bornova-IZMIR., pp: 164.
53. Ali, A. and P.Q. Rizvi, 2007. Developmental response of cabbage butterfly, *Pieris brassicae* L. (Lepidoptera: Pieridae) on different cole crops under laboratory and field conditions. Asian J. Plant Sci., 6: 1241-1245.
54. Younas, M.M., M. Naeem, A. Raquib and S. Masud, 2004. Population dynamics of *Pieris brassicae* on five cauliflowers at Peshawar. Asian J. Plant Sci., 3: 391-393.
55. Feltwell, J., 1978. The depredations of the large white butterfly (*Pieris brassicae*) (Pieridae). J. Res. on the Lepidoptera, 17: 218-225.