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Important insect pests in winter vegetables grown in Beydere Seed Certification Test Directorate

Beydere Tohum Sertifikasyon Test Müdürlüğünde yetiştirilen kışlık sebzelerde görülen önemli zararlı böcek türleri

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ABSTRACT

This study was carried out in Beydere Seed Certification Test Directorate (Manisa) between 2016-2018 with the aim of detecting important insect pests species in winter-grown vegetables such as artichoke, cauliflower, broccoli, spinach, cress, lettuce, parsley, arugula, dill, beet, carrot, white cabbage, red cabbage and Brussels sprouts. In the result of study, as insect species *Gryllotalpa gryllotalpa* (Linnaeus) (Orthoptera: Gryllotalpidae), *Brevicoryne brassicae* (Linnaeus) (Hemiptera: Aphididae), *Eurydema ornata* (Linnaeus) (Hemiptera: Pentatomidae), *Sphaeroderma rubidum* (Graells), *Phyllotreta* sp. and *Cassida rubiginosa*, (Müller) (Coleoptera: Chrysomelidae), *Mamestra brassicae* (Linnaeus) (Lepidoptera: Noctuidae), *Hellula undalis* (Fabricius) (Lepidoptera: Pyralidae), *Phragmacossia albida* (Erschoff) (Lepidoptera: Cossidae), *Pieris brassicae* (Linnaeus), *Pieris napi* (Linnaeus) and *Pieris rapae* (Linnaeus) (Lepidoptera: Pieridae), *Plutella xylostella* (Linnaeus) (Lepidoptera: Plutellidae) and *Delia radicum* (Linnaeus) (Diptera: Anthomyiidae) were determined. Among them, the most important pests species were determined as *B. brassicae*, *E. ornata*, *P. brassicae* and *D. radicum*. It was determined that these pests species caused intense damage in head (white-red) cabbage, but the density was low in broccoli.

INTRODUCTION

Compared to many countries, Turkey has a very rich fauna and flora in its climate zone and is among the important countries of the world in terms of natural richness. In terms of vegetable growing, it is among the most important vegetable producer countries in the world and Europe in terms of both the number of species and varieties and the amount of production (Yanmaz et al. 2015).

Red, white and brussels sprouts, cauliflower, broccoli, arugula, cress, from leafy vegetables lettuce, cabbage, spinach, chard, purslane, edible vegetables, tomato, pepper, eggplant, cucumber, pumpkin, melon, watermelon, flower and flower table edible vegetables, cauliflower, broccoli, artichoke, okra, fragrant herbs, parsley, dill, mint, cress, arugula, sorrel and many other wild and other vegetable

species are grown in Turkey (Faydaoğlu and Sürücüoğlu 2011). It is stated that there are many pests and beneficial species in vegetable growing areas, and the pests do not only harm the vegetables, but also negatively affect the economy by reducing the market value of the products. As in cultivated plants, it is of great importance to detect and management diseases and pests with an appropriate method, together with fertilization, irrigation and other agricultural techniques, in increasing the yield of Cruciferae vegetables (Tozlu et al. 2002).

Vegetable production can be increased in various ways. One of them, to obtain more and quality products from the existing area, it is the correct and timely application of management methods against diseases and pests that cause quality and quantity losses in vegetables. The way to achieve this is possible with full knowledge of diseases and pests. No study has been carried out on pest species found in winter vegetable species in the area where the study was conducted. The aim of this study is to determine pest species and their density in winter vegetable species, and to obtain some information about pests species by making some biological observations.

MATERIALS AND METHODS

The material of the study, it was consisted of samples of pest species in winter vegetables grown in Beydere Seed Certification Test Directorate (Figure 1) located in Selimşahlar neighborhood of Şehzadeler district of Manisa province.

Figure 1. Study area in Beydere Seed Certification Test Directorate (Latitude 27.511536º E Longitude 38.732966º N)

Collection of material

In order to determine the harmful insect species in the study area, weekly surveys were carried out and pest species were collected in artichoke (*Cynara scolymus*), cauliflower (*Brassica oleracea* var. *botrytis*), broccoli *(Brassica oleracea* var. *italica*), spinach (*Spinacia oleracea*), cress (*Lepidium sativum*), lettuce (*Lactuca sativa*), parsley (*Petroselinum crispum*), arugula (*Eruca vesicaria*), dill (*Anethum graveolens*), beet (*Beta vulgaris*), carrot (*Daucus carota* subsp. *sativus*), white cabbage (*Brassica oleracea* var. *capitate*), red cabbage (*Brassica oleracea* var. *capitata f. rubra*) and Brussels sprouts (*Brassica oleracea* var. *gemmifera*) during the winter vegetable production vegetation in 2016-2018 (January-December). For this purpose, the root collar, stem, branch, shoot, leaves, flowers and fruits of the plants were visually examined from each vegetable field cultivated, and samples belonging to the adult and pre-adult periods were taken.

Coordinates and heights of the study areas were determined by using the GPS (Global Positioning Systems) device. In addition, the host plant information from which the samples collected was recorded. To the collection of samples sweep net, visual control, leaf counting and culturing methods were used in the study.

Sweeping net method

This method was used to capture motile or low-motility species in vegetable production areas and to determine their population densities. In this context, starting from the inside of each trial area, a total of 50 sweep nets, 10 of them, were shaken by contacting randomly and sweeping the plants in every 15-20 steps in the direction of the diagonal by contacting the plants in a way that sweeps the plants (Anonymous 2023a, Kaya and Kornoşor 2008). Pests caught in the sweep net were put in kill bottles or in transparent polyethylene bags, killed with a few drops of ethyl acetate dripped on blotting paper, and brought to the laboratory in an ice container with the label containing the collection information (Ölmez et al. 2021). The samples were classified at the order and family, and after they were labeled appropriately, they were identified.

Some insects that did not come to the sweep net were taken from the plants using a sable brush and aspirator, and the necessary information was recorded. In the observations made in the field, yellowing, wilting, drying or the underground and above-ground parts of the plants that were eaten by the pest and the soil or weeds around it were also examined, and it was investigated whether there were harmful insects.

Visual control method

This method was used to determine the population densities of some pest species in the experimental areas from the beginning of flowering during the vegetation period. For this purpose, the surveyed fields were visited once a week, each field was entered in the direction of the diagonals, the plants examined according to the size of the field was chosen randomly, all parts of the selected plants (stem, branch, shoot, leaf, fruit, etc.) were checked. In large-leaf lettuce and spinach, 10-20 plants in 100-1000 m^2, and in small-leaved parsley, arugula, cress, dill, mint, basil and purslane, 50 plants in 100-1000 m2 were examined (Anonymous 2023b). While sampling, the plants were checked one by one and the

pests obtained were taken into the killing bottle. Then, the insects were taken from the killing bottles with the help of a mouth aspirator and put into plastic-lidded boxes with label information.

Cultivation method

Pre-adult specimens such as larvae and pupae in the survey areas were cut together with the plant organ they were in or taken with the help of a forceps, and put together with their label information in plastic storage boxes that are suitable for air intake and adult emergence was achieved by culturing in the laboratory (at 25 ± 1 °C, 60% ± 10% proportional humidity, 16 hours of light and 8 hours of dark). The cultured samples were checked daily, and the nutrients in the culture boxes were replaced with new ones as long as the feeding process of the larvae continued (Kaya and Kornoşor 2008). Adult individuals of the pest species obtained from the culture were prepared in accordance with the diagnosis together with the label containing the collection information and separated according to their families.

Preparation of samples

Adult specimens collected in the survey areas were brought to the laboratory and separated from plant particles, and small-sized adults were glued on triangular papers, and large-sized individuals were pinned directly. From the pre-adult periods, firstly, adults were obtained, and then sticking and pinning processes were started. Water-soluble glue (glotofix) was used as the adhesive material. Care was taken not to damage the parts of the insect body used as a diagnostic character while pinning and sticking on triangular cardboard, and samples made ready for diagnosis. The species were identified by Erol Yıldırım by looking at the diagnosed specimens in Atatürk University, Faculty of Agriculture, Department of Plant Protection Entomology Museum.

RESULTS AND DISCUSSION

This study was carried out between 2016-2018 to determine the pest species seen in the vegetables artichoke, cauliflower, broccoli, spinach, cress, lettuce, parsley, arugula, dill weed, beet, white cabbage, red cabbage, and Brussels sprouts produced in Beydere Seed Certification Test Directorate in

Table 1. Orders, families and host plant species of the species determined in the study

Order	Family	Species	Host plant species
Orthoptera	Gryllotalpidae	*Gryllotalpa gryllotalpa* (Linnaeus)	Brassica oleracea var. capitata f. alba, B. oleracea var. capitata f. rubra, B. oleracea gemmifera, B. oleracea var. botrytis L., B. oleracea var. italica Plenck
Hemiptera	Aphididae	*Brevicoryne brassicae* (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. capitata f.rubra, B. oleracea gemmifera, B. oleracea var. botrytis L., B. oleracea var. italica Plenck, Sinapis arvensis L.
	Pentatomidae	*Eurydema ornata* (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. capitata f.rubra, B. oleracea var. botrytis L., B. oleracea var. italica Plenck
		Sphaeroderma rubidum (Graells)	Cynara scolymus L.
Coleoptera	Chrysomelidae	*Phyllotreta* sp.	B. oleracea var. capitata f. alba, B. oleracea var. botrytis L., B. oleracea var. italica Plenck, Wild crucifers
		Cassida rubiginosa O.F. Muller	Cynara scolymus L., Beta vulgaris L., Spinacia oleracea L.
Lepidoptera	Noctuidae	*Mamestra brassicae* (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. botrytis L., B. oleracea var. italica Plenck, B. oleracea gemmifera, Spinacia oleracea L., Lactuca sativa var. capitata L.
	Pyralidae	*Hellula undalis* (Fabricius)	B. oleracea var. capitata f. alba, B. oleracea var. capitata f. rubra, B. oleracea var. botrytis L.
	Cossidae	*Phragmacossia albida* (Erschoff)	Cynara scolymus L.
	Pieridae	*Pieris brassicae* (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. capitata f. rubra, B. oleracea var. botrytis L., B. oleracea var. italica Plenck, B. oleracea gemmifera
		Pieris napi (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. capitata f. rubra, B. oleracea var. botrytis L.
		Pieris rapae (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. capitata f. rubra, B. oleracea var. botrytis L., B. oleracea var. italica Plenck, Wild crucifers
	Plutellidae	*Plutella xylostella* (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. capitata f. rubra, B. oleracea gemmifera, B. oleracea var. italica Plenck, B. oleracea var. botrytis L.
Diptera	Anthomyiidae	*Delia radicum* (Linnaeus)	B. oleracea var. capitata f. alba, B. oleracea var. botrytis L., B. oleracea gemmifera, B. oleracea var. italica Plenck

Selimşahlar neighborhood of Şehzadeler district of Manisa province. As a result of the study, a total of 14 pests species [(*Gryllotalpa gryllotalpa* (Linnaeus), *Brevicoryne brassicae* (Linnaeus), *Eurydema ornata* (Linnaeus), *Sphaeroderma rubidum* (Graells), *Phyllotreta* sp., *Cassida rubiginosa* Müller, *Mamestra brassicae* (Linnaeus), *Hellula undalis* (Fabricius), *Phragmacossia albida* (Erschoff), *Pieris brassicae* (Linnaeus), *P. napi* (Linnaeus), *P. rapae* (Linnaeus), *Plutella xylostella* (Linnaeus) and *Delia radicum* (Linnaeus)] belonging to 5 orders and 10 families were determined (Table 1). As a result of a study carried out in Bitlis, Muş and Van provinces, 21 pests species from 12 families belonging to 4 orders were determined in the cabbage cultivation areas, and among them *Pieris rapae* L., *P. brassicae* (Cabbage butterfly), *Hellula undalis* (Fabricius) (Pyralidae) (Cabbage bellyworm), *Plutella xylostella* L., (Yponomeutidae) (Cabbage leaf moth), *Spodoptera littoralis* (Bois.) belonging to the Lepidoptera order and *Aleyrodes proletella* L. (Aleyrodidae) (Cabbage whitefly) belonging to the Hemiptera order were determined as the main important damage species (Ölmez et al. 2021).

As a result of field studies, it was observed that *Pieris brassicae* was the most economically important species among the pests' species detected. When monitoring the population of this species, it was determined that adults were showed in nature in the second week of February or first week of March, and it was observed that it reached the highest population in May and June. In the study, pheromone trap counting was not performed. These are purely observational findings. It was also determined that the adult and pre-adult stages of *P. brassicae* remained active in nature for about eight months, from the second week of February to the second week of October. It was observed that *P. brassicae* prefer cabbage (white and red), cauliflower, broccoli, Brussels sprouts, and many wild crucifers. It was indicated that they heavily damaged cabbage (white and red) and cauliflower, and they preferred broccoli, Brussels sprouts and many wild crucifers less in the study area. In a study conducted in İzmir, it was stated that *P. brassicae* is the most common pest of cabbage and cauliflower (Uzun 1987). In another study conducted in the Eastern Mediterranean Region, it was indicated that this species harms cabbage (*B. oleracae*) and cauliflower (*B. oleracae* var. *botrytis*) (Bayhan et al. 2002). It was determined that the larvae initially gnawed superficially between the veins of the leaves, and over time they left only the thick veins by eating the leaves of the plant they were feeding on. Extremely damaged plants show a bushy appearance (Figure 2), rain and dew droplets and excrement accumulated between the leaves of the plant cause the cabbage to become inedible. It was determined that the biology of *Pieris napi* (Linnaeus), another species belonging to the same genus, is similar to *P. brassicae*, but laid its eggs one by one. It was determined that *Pieris rapae* (Linnaeus) fed on white and red cabbage, cauliflower, broccoli and many wild crucifers, and laid its eggs on the cabbage plant one by one, like *P. napi*. It was determined that *Phragmacossia albida* (Erschoff) preferred artichoke. It was found that the larvae of the pest caused the roots in which they were found to rot by hollowing out, and the root of the plant, which was hollowed out, rots after a while. It has been stated that the main host of this species is artichoke and it damages this plant, and it spends the winter in the plant body and in a strong cocoon, usually in the seventh and later larval stages. In addition, it has been stated that the larvae emerging from the eggs laid near the root collar and root of the plants enter the plant through fresh shoots, cracks and nipples and feed (Özbek and Hayat 2003). Another lepidopteran species, *P. xylostella*, was detected in white and red cabbage, Brussels sprouts, broccoli and cauliflower plants. In a conducted study, it was stated that *P. xylostella* harmed broccoli (*B. oleracea* var. *italica* Plenck), brussels sprouts (*B. oleracea* var. *gemmifera*), cabbage (*B. oleracea* var. *capitata*), Chinese cabbage (*B. rapa* subsp. *pekinensis* Lour), cauliflower (*B. oleracea* var. *botrytis* L.), collard (*B. oleracea* var. *viridis* D.C.L.), kale (*B. oleracea* var. *sabellica* L.), kohlrabi (*B. oleracea gongylodes* D.C.L.), mustard (*B. juncea*), radish (*Raphanus sativus* var. *longipinnatus*), turnip (*B. rapa* subsp. *rapa*), and watercress (*Nasturtium officinale* W.T.Aiton) and a few wild crucifers (Saran and Genç 2021). It was found that the larvae of the pest went out of the leaf and fed by gnawing the leaves from the bottom to the upper epidermis, and only a thin membrane remained on the upper side of the gnawed parts. After a while, it was determined that the leaves turned into a very perforated appearance, both large and small. In addition, it was determined that this species was densely populated on wild crucifer plants around cabbage fields. Cabbage moth, *M. brassicae* was determined to cause damage to cabbage, cauliflower, broccoli, brussels sprouts, spinach and lettuce. It was determined that the pest fed on especially on the navel section of the cabbage plant, and the flowers and leaves of the cauliflower. It was reported that M. brassicae is the most serious pest of vegetables in the Brassica genus in Asia and Europe (Finch and Thompson 1992). In another study, it was stated that *M. brassicae* caused up to 80% damage in *Brassica* (broccoli, arugula, bok Choy, Brussels sprouts, cabbage, cauliflower, radish, turnip and watercress) vegetables (Cartea et al. 2009). Cabbage belly worm, *H. undalis*, was observed to prefer white, red cabbage and cauliflower. In the areas where the study was carried out, it was determined that it caused damage to cabbage and cauliflower plants in July from the seedling production date to the end of vegetation; however, the population density was low. In a study in the Eastern Mediterranean Region,

it was determined that the damage caused by *H. undalis* on white cabbage (*B. oleracea* var. *capitata f. alba*), red cabbage (*B. oleracea* var. *capitata f. rubra*) and cauliflower (*B. oleracea* var. *botrytis*) is very important. It was stated that the damage especially in cauliflower (*B. oleracea* var. *botrytis*) increased up to 100% and no product could be obtained (Yabaş and Zeren 1990).

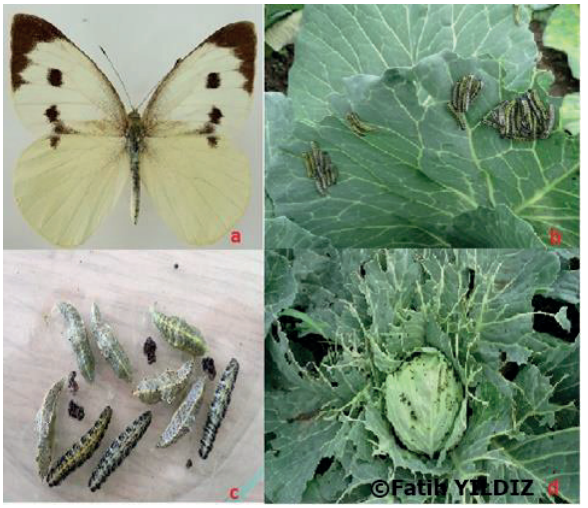

Figure 2. *Pieris brassicae* (Linnaeus) adult (a), larvae (b), mature larvae and pupae preparing to pupate (c), damage to cabbage plant (d)

When monitoring the population of *Eurydema ornata*, it was observed as the second pest species that is important in terms of density and economy in vegetable cultivation areas. It was determined that the pest was seen intensely with the seedling period in September and in the flowering periods in June and July. It was found that reached to the highest population in April and June, causing color change in the leaves and drying in advanced cases. It was determined that the population density of *E. ornata* was high in white cabbage, red cabbage and Brussels sprouts belonging to the Cruciferae family, while the population density was low in cauliflower and broccoli in the study area. These are purely observational findings. In a study conducted in the Aegean region, it was stated that seven species of *Eurydema* were detected and these pest species damaged cabbage and cauliflower seedlings belonging to the Cruciferae family. In addition, the researchers stated that the dominant species was *Eurydema ventral* Klt. while the second most common species was *E. ornata* (Atalay and Çağlayan 1990). It was determined that the pest caused damage by sucking the sap of the host plant and was caused curling in the leaves, whitish-yellow spots on sucking sites, and that in time, the spots combine and was caused them to drying and spilling (Figure 3). It was stated that except for the first instar nymphs of the pests, the nymphs and adults of the other instar is fed on the leaves and was caused sucking spots with a diameter of 1.06-3.72 mm (Atalay and Çağlayan 1990). As a result of feeding, it was determined that the vascular tissues of the host plant were damaged, especially in the seedling period, as they caused a lot of damage, preventing the development of the seedling and causing them to dry out. In addition, it was determined that this species released a foul odor in the places where it was fed, unlike other species.

Figure 3. *Eurydema ornata* (Linnaeus) adult (a) and egg (b)

According to observational findings, *B. brassicae* was observed to be dense in white cabbage (*B. oleracea* var. *capitata f. alba*), red cabbage (*B. oleracea* var. *capitata f.rubra*), Brussels sprouts (*B. oleracea gemmifera*) and wild mustard plants (*Sinapis arvensis*) belonging to the Cruciferae family, and a lower population was observed in cauliflower (*B. oleracea* var. *botrytis*) and broccoli (*B. oleracea* var. *italica*) in the study area. It was determined that this species caused curling and deformities in the leaves and fresh shoots they feed on (Figure 4). It was detected for the first time in our country on cabbage (Avcı and Özbek 1991, Bodenheimer and Swirski 1957, Düzgünes and Tuatay 1956, Düzgünes et al. 1982, Giray 1974). In another study, it was stated that it fed on white head cabbage (*B. oleracea* var. *capitata f. alba*), leaf cabbage (*B. oleraceae* var. *acephala*), red head cabbage (*B. olareacae* var. *capitata* subsp. *rubra*), *Brassica* sp., *Ochtodium aegyptiorum*, radish (*Rhaphanus sativus* L.), wild mustard (*Sinapis arvensis* L.), *Sinapis* sp., *Brassica* sp. and canola (*B. napus* var. *oleifera*) (Toros et al. 2002).

Figure 4. *Brevicoryne brassicae* (Linnaeus) on cabbage plant preparing to seed

Gryllotalpa gryllotalpa (Figure 5), which is one of the harmful species, was observed to damage white cabbage, red cabbage, Brussels sprouts, cauliflower and broccoli in the study area. It was stated that adults and nymphs of *G. gryllotalpa* move forward by opening a gallery in the soil, gnawing and damaging all kinds of plant materials such as seeds, roots and tubers; they caused drying by cutting the roots of newly planted or newly germinated vegetable seedlings. On the other hand, it was also stated that the pest gnawed the tubers of tuberous vegetables and damaged the roots by cutting almost all in vegetable seedlings (Erdoğan 2006). In another study, it was indicated that the pest caused significant damage in the seedling period of cabbage, tomato, eggplant, pepper, potato and onion plants in Elazığ, Mardin, Malatya, Tunceli, Erzincan and Siirt provinces, which are important in terms of vegetable growing in the Eastern and Southeastern Anatolia Regions (Asena 1972).

Figure 5. *Gryllotalpa gryllotalpa* (Linnaeus) adult

It was observed that the artichoke leaf beetle, *S. rubidum* created high populations on the artichoke plant and fed on the leaves. It was indicated that the early instar larvae of *S. rubidum* fed on the primary and secondary leaf veins, and the next instar larvae fed on all leaf texture between the upper and lower epidermis (Anonymous 2023c). On the other hand, it was observed that *C. rubiginosa* caused damage on artichoke leaves and also fed on beet (*Beta vulgaris* L.), spinach (*Spinacia oleracea* L.) and some wild cruciferous herbs. In a study conducted in the artichoke fields in Center and Ezine districts of Çanakkale province, it was stated that *C. rubiginosa* caused intense damage to the leaves of the artichoke plant, and they also damaged the outside parts of the flowers that had not yet opened, but this damage remained at a small level (Efil 2018). It was observed that *Phyllotreta* sp., which is one of the soil fleas, created dense population in cabbage, cauliflower, broccoli and wild crucifers. In addition, during the visual inspections, it was observed that the adults of the pest damaged on the leaves of carrot, spinach, lettuce, eggplant, beet, and they ate the leaves in the young stages of the plants and adversely affected the leaf quality. Although *Phyllotreta* spp. was the predominant pest of the canola plant, it was stated that it harms vegetables belonging to the Cruciferae family (*Brassicae* spp.) (Burgess 1977, Wylie 1979).

It was observed that the larvae of *D. radicum* L. from the order Diptera, which is one of the harmful species, caused damage to cabbage, cauliflower, Brussels sprouts, broccoli and turnip plants, respectively. It was stated that *D. radicum* damaged cultivated plants belonging to the Cruciferae family, such as cabbage (*B. oleracea* var. *capitata* L.), cauliflower (*B. oleracea* var. *botrytis* L.), turnip (*B. napus* subsp. *rapifera*) and radish (*Raphanus sativus* L.) (Maack 1977, McKinlay and Birch 1991). It was determined that pest larvae caused damage and stress to the host plants as a result of fed on the root and root collar of the host. It was observed that as the number of larvae per plant increased, the damage rate also increased. In addition, when the plants took a certain size, it was seen that the head binding (plate) was not at the desired level, although the damage was tolerated.

In vegetable production, which is an important source of income for the regional economy, experiences product and quality losses due to various factors. Among the factors affecting this yield and quality, pests hold an important place. As a result of this study, pests species found in winter vegetables produced in Manisa province were determined, among these species, the leading species were determined in terms of density and damage observationally. In addition, some data about the damage shape of the species and the time of their have in nature are given. These results are extremely important both in terms of shedding light on future studies and in terms of producers making use of these data.

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ÖZET

Bu çalışma Beydere Tohum Sertifikasyon Test Müdürlüğünde (Manisa) kışlık yetiştirilen enginar, karnabahar, brokoli, ıspanak, tere, marul, maydanoz, roka, dereotu, pancar, havuç, beyaz lahana, kırmızı lahana ve brüksel lahanası gibi sebzelerde görülen önemli zararlı böcek türlerini tespit etmek amacı ile 2016-2018 yıllarında yürütülmüştür. Çalışma sonucunda zararlı türlerden *Gryllotalpa gryllotalpa* (Linnaeus) (Orthoptera: Gryllotalpidae), *Brevicoryne brassicae* (Linnaeus)

(Hemiptera: Aphididae), *Eurydema ornata* (Linnaeus) (Hemiptera: Pentatomidae), *Sphaeroderma rubidum* (Graells), *Phyllotreta* sp. ve *Cassida rubiginosa* (Müller) (Coleoptera: Chrysomelidae), *Mamestra brassicae* (Linnaeus) (Lepidoptera: Noctuidae), *Hellula undalis* (Fabricius) (Lepidoptera: Pyralidae), *Phragmacossia albida* (Erschoff) (Lepidoptera: Cossidae), *Pieris brassicae* (Linnaeus), *Pieris napi* (Linnaeus), *Pieris rapae* (Linnaeus) (Lepidoptera: Pieridae), *Plutella xylostella* (Linnaeus) (Lepidoptera: Plutellidae) ve *Delia radicum* (Linnaeus) (Diptera: Anthomyiidae) türleri tespit edilmiştir. Bunlar içerisinde en önemli zararlı türlerin; *B. brassicae*, *E. ornata*, *P. brassicae* ve *D. radicum* olduğu belirlenmiştir. Bu zararlı türlerin baş (beyaz-kırmızı) lahanada yoğun olarak zarar verdiği, ancak brokolide yoğunluğun düşük olduğu belirlenmiştir.

Anahtar kelimeler: kışlık sebze zararlıları, Brassicaceae, kışlık sebzeler, Manisa, Türkiye

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