THREAT DATA

Turnip moth

(*Agrotis segetum*)

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(*Agrotis segetum*)

The turnip moth is a moth of the family Noctuidae. It has a number of common English and scientific names including turnip moth and *A. segetum* respectively. This pest was first described in 1775 under the name *Noctua segetum* by Denis and Schiffermuller. It is a common European species, but is also present in other parts of the world. *A. segetum* is consider a broad polyphagous insect that cause damage to many vegetable, cereals, grains and crops including tea.

Distribution: *A. segetum* is a common European species, but is also present in many of Asian, Middle East and African countires (ref CPC). This insect is not believed to be present in the United States, where its possibility of entry with imported food crops been cheked regularly. *A. segetum* is not currently recorded in Australia and New Zealand.

Host range: Including tea and coffee, *A. segetum* has very wide host range. It attacks cultivated plants belonging to more than 15 families (e.g. cotton, tomatoes, maize, grain legumes, tobacco, sunflower, sugar beet, winter cereal etc). In Russia and adjacent countries the larvae populate more than 160 plant species. In addition to cultivated host**,** *A. segetum* has number of wild host Couch-grass (*Agropyrum*), Bindweed (*Convolvulus*), plantain (*Plantago*), etc. The female lays their eggs in wild host and than attack cultivated plants.

Habitat: Areas of cultivated tea, coffee, cereal, grains legumes, and vegetable crops.

Biology and Ecology: Depending on local conditions (e.g. temperature) *A. segetum* has **1 to 2 annual generations**, sometimes, a partial third. Adults generally emerge from pupae during the day but do not become active until dusk. Mating my take place on the night of emergence or later and depending on environmental conditions each female mate 1-3 times (Gomaa, 1978) in their life. After a 3-4 day pre-ovipositional period each female lays several hundred **eggs** (**800-1200**) over about 6 days (Esbjerg, 1992). The eggs are laid one by one, occasionally in groups of 2-3 on plant residues, on the ground, and on the lower side of weed leaves adjoining soil surface or aggregating in a rosette. Development of eggs lasts 3 to 24 days depending on temperatures. Eggs are spherical shape (0.5-0.6 mm) with while colour at early stage. Larvae develop in 24-40 days, reaching 40-52 mm in length at the last 6th instar. The young caterpillar first nibbles the wild plants and then attacks the neighbouring cultivated species. It feeds at night, gnawing the foliage and cutting the petioles. During the day, it conceals itself by rolling up under a lump of earth or at a slight depth in the ground. The species overwinters as a caterpillar.

The size and colour of adult moths are varied. The body length is 18-22 mm with 34-45 mm wingspan. It has dark brown fore wings with uniform and a clearer circular spot in the middle. The rear wings are white in the male and grey in the female. The periphery of the wings bears a thin black border. Females have setaceous antennae but males have comb-like antennae (figure in the cover page).

Symptoms: Leaves, stalks and stems of the affected plants show external feeding with abnormal leaf fall. In case of roots and stems both external and internal feedings are visible. The whole leaf may fall off the plant after being cut through at the base of the stalk by the larvae (fig. B).

Fig A). Attack on collar of beat

Fig B). Larva on lettuce plant

Affected plant stages: Seedling and vegetative stages.

Affected plant parts: Leaves, roots and stems

Affected Industries: Tea, coffee and other crops.

Affected time of the year: The adults appear in early summer and remain active throughout the summer period (ref. CPC).

Pest detection: In some crops (e.g. carrots), premature leaf falling caused by young larvae may indicate the presence of the pest, but by then it may not be possible to save the crop. Holes and cavities in roots and tubers are useful for mapping and assessing attacks levels. Larvae (45-50 mm) with greyish body and reddish head are visible infested plant parts.

Pest movement and Dispersal: The natural dispersal of *A. segetum* is negligible in stages other than the adult moth. The moth is a strong flier capable of flying against winds of up to 6-8 m/s (ref CPC). Plant parts not known to carry the pest in trade and transport are – Bark, Bulbs/Tubers/Corms/Rhizomes, Flowers/Inflorescences/cones/Calyx, Seedlings/Micropropagated plants, True seeds (including grain), Wood.

Natural Enemies: *A. segetum* has over 50 parasites that mainly attack on the larval stage (Alekseev 1972, Eremenko and Sem'yanov 1981). Most parasites are Hymenoptera, in particular, species in the families Braconidae and Ichneumonidae. Parasitic flies are also important parasitoids. Many of the parasitoids are not host-specific and some have a wide geographical distribution. Studies on predators, mainly beetles, have been carried out in Poland Uzbekistan, India, and Japan but the impact of the predators has not been studied. Among the pathogens viruses, bacteria, and fungi are being reported without any quantitative information (ref. CPC).

Pest impact: Including tea, *A. segetum* are capable of causing economic damage to a large number of agricultural and horticulture crops because of its wide range of host capacity. The insect larvae usually attacked seedling stage of tea and destroy the seedlings. The total damage caused by this insect is not available for tea but there are many reports on other crops. For example, 3-37% of cotton seedlings destroyed in China (Hu, 1982), and in Kazakstan 17.5% of young maize plants destroyed have been reported by Shek and Bulavskaya (1978). Neupane and Bhimsen (1971), in Nepal, estimated a loss of 33% of potatoes and a 24% weight loss caused by 7.8 larvae/m². Kay and Wheatley (1979), in the UK, found 34% of beetroots were damaged at a density of 14 larvae/m² and 17% of young lettuces were destroyed at a density of 3.5 larvae/m². However, Kay and Wheatley also found that 34 larvae/m² had no economic impact on mature lettuces. In Denmark, damage levels of 10-25% for carrots and 3-68% for beetroots are common if the larval period of *A. segetum* coincides with three to four dry, warm weeks (Esbjerg, 1985). In Germany, Cruger (1978) could find hardly any undamaged potatoes at a larval density of 200 larvae/m². Barbulescu (1973) described damage to a variety of crops in Iran as very severe at a density of 90 larvae/m² (ref. CPC). In field experiments, damage levels of up to two carrots per larva or about 50% damaged carrots at a larval density of 30-35 larvae/m² were found under very dry conditions; however, the damage level is about half of this under normal conditions (Esbjerg,1989).

Management: *A. segetum* can be managed by different control measures depending on crops, field conditions, infection severity, and availability of the techniques. Control measures include: cultivation of resistant varieties, weeding, removal of crop residues from fields, deep autumn plowing, inter-row cultivations, optimal dates of early sowing, including vetch-oat sown fallows in crop rotation, digging defensive ditches and furrows, watering, application of green poisonous baits, insecticide treatments of seeds and plantlets, release of such entomophages as Trichogramma spp., application of such bio-preparations as Lepidocide, Virin, Dendrobacillin and Bitoxibacillin. Monitoring is possible by use of sex pheromone traps.

- **Host-Plant Resistance:** Little information is available on host-plant resistance in *A. segetum*. Methanol extracts of potato tubers and wheat germ deterred oviposition (Anderson and Löfquist, 1996) and in Denmark careful weeding of onion fields is recommended as a preventive measure because the first-instar larvae cannot survive on onion plants (Esbjerg et al., 1995). For an insect as polyphagous as *A. segetum*, it is unlikely that host-plant resistance will be developed.

- **Chemical Control:** Unless persistent chemicals were used, chemical control used to be variable, however, basing the timing of treatment on the results from pheromone traps improved its efficacy. Since then, the use of synthetic **pyrethroids** directed against first-, second- and third-instar cutworms has proved to be very easy and it is highly efficient when based on information from pheromone traps (Esbjerg, 1985; Esbjerg et al., 1996).

- **Cultural Control:** Less damage occurs in the humid areas of a field (Herold, 1919). Esbjerg et al. (1995) discussed using systematic irrigation against small larvae in organic vegetable production. This has been put in practise with support for timing of irrigation by a PC-based forecasting model utilising trap catches and local weather records (Nilars and Esbjerg, 1998). It may be better not to earth up around leek plants too early because the larvae are more likely to survive in the drier and warmer top soil of the ridges. Careful weeding of onion fields may also be beneficial because the early instars of *A. segetum* cannot survive on onions.

- **Biological Control:** Many experiments on the different types of biological control carried out against *A. segetum* but there is no review of biological control for this species. Beneficial nematodes will attack and destroy cutworms in the soil. Release trichogramma wasps weekly for three consecutive weeks to parasitise cutworm eggs. Diatomaceous earth sprinkled around the base of plants is very effective. Scatter bran or corn meal mixed with Dipel Dust (*Bt-kurstaki*) and molasses on the soil surface to kill caterpillars. Eco-Bran will also kill caterpillars that feed on it. After harvest pick up garden debris and turn the soil over around plants to disturb overwintering larvae.

- **Integrated Pest Management:** Programmes combining cultural, biological and chemical control methods have been initiated in Denmark (Esbjerg et al., 1983) and the results are being put into practice in Denmark and Sweden. In Denmark these results and other later results provide the background for integrated production (IP) of carrots (Esbjerg, 1999).

Quarantine Risk: Moderate – following establishment *A. segetum* has potential to spread by natural means as adults are strong flyer and the larvae can also spared by soils and infested plant parts. The economic damage causes by this pest would be high because of its wide host range.

Probabilities of Entry: Low. *A. segetum* can enter into Australia mainly through infested vegetative plant parts and the larvae are quite visible, therefore under proper quarantine it has low possibility of entry into the country.

Possibility of Establishment: High – wide host range (both cultivated and wild plant species) of *A. segetum* makes a high possibility of finding a proper host after entry into Australia. This also support by a suitable climatic condition for the pest in many parts of the country.

Economic Impact: High - based on pest biology, multiple host rang, the nature of damage reported by *A. segetum* and the availability of effective management practices.

Environmental Impact: Low to moderate – *A. segetum* is capable of attack multiple plant species including cultivated and wild plants. However, in nature the pest has many biological enemies that are commonly used in biological control rather then fully depend on chemicals. This indicates the limited chemical applications to keep the pest population under control in field.

Social Impact: Low – although natural enemies of *A. segetum* may keep the population under control but in severe cases the management cost may rise beyond the profit level of small grower in local community. A wide host capacity of this pest is another concern of its broad impact on a number of different crops of local farmers.

Pest Management cost: Low/moderate – depending on pest severity, crops and methods used the cost may vary from $300 – 600/ha. This cost excludes involvement of any biological control and or resistant plant varieties. Effective and established control practices (both cultural and chemical) are available for *A. segetum*. However, the management with cultural practice could be more expensive in case pest severity.

Yield loss despite control efforts: Based on pest biology, available control measures, and its impact on the host plant the total yield loss assumed to be between 10 – 20% for individual crop under proper control measures.

Export revenue loss due to loss of Pest Freedom Status: Low - *A. segetum* has limited capacity to disperse via infested plant parts (mainly vegetative) during international trade under regular quarantine process.

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