



## First record of the fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797)

### (Lepidoptera: Noctuidae) in Türkiye

Serkan PEHLİVAN<sup>1\*</sup>, Ekrem ATAKAN<sup>1</sup>

#### ABSTRACT

The fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797) (Lepidoptera: Noctuidae), is a key pest of the many economically important crops, especially maize throughout the world. *Spodoptera frugiperda* is indigenous in the Americas, but now it has rapidly spread over more than 50 countries in Africa and Asia continents. In the EPPO region, the first occurrence of *S. frugiperda* was in Egypt in 2019, while then in Southern Israel in 2020, most recently in Syria. During the maize field surveys performed randomly, *S. frugiperda* larvae were detected for the first time in Adana Province (Türkiye). The species was identified based on the morphological characters of the larvae. Due to the end of the growing season in Adana Province, only four fields were controlled, and all of them were infested with the *S. frugiperda* larvae. The rate of infected plants was varied between 14 and 15%. The climatic conditions are quite suitable for this pest in Adana. It obviously shows that this invasive pest may multiply and spread over to arable crops mainly maize fields throughout the year without entering diapause in this region, and it may have great potential to become a major pest of maize in the region.

**Key words:** Fall armyworm, first report, invasive pest, maize, Adana, Türkiye.

## Türkiye’de Güz tırtılı *Spodoptera frugiperda* (J.E. Smith, 1797) (Lepidoptera: Noctuidae)’nın ilk kaydı

#### ÖZ

Güz tırtılı *Spodoptera frugiperda* (J.E. Smith, 1797) (Lepidoptera: Noctuidae) dünyada mısırında içinde bulunduğu pek çok üründe ana zararlı konumundadır. Orijini Amerika kıtası olan *S. frugiperda*, Asya ve Afrika kıtasında 50’den fazla ülkeye yayılmış durumdadır. EPPO bölgesinde ilk defa 2019 yılında Mısır’da tespit edilmiş olup, sonrasında 2020 yılında Güney İsrail ve son olarak da Suriye’de belirlenmiştir. Tesadüfi olarak yapılan mısır tarlalarının sürveyleri sırasında Adana İli’nde bu zararlı ilk kez saptanmıştır. Bu zararlı larvaların morfolojik özelliklerine göre teşhis edilmiştir. Adana İli’nde üretim sezonunun sonuna geldiği için sadece dört tarla kontrol edilmiş ve tüm tarlalar *S. frugiperda* ile bulaşık bulunmuştur. Bu zararlı ile bulaşık bitki oranı %14-15 arasında değişmiştir. Adana İlinde iklim koşulları bu zararlı için uygun olabilir. Bu durum, istilacı zararlının bu bölgede diyapoza girmeden neredeyse yıl boyunca çoğalıp yayılabileceğini ve özellikle mısır üretim alanlarında önemli bir zararlı olma potansiyeline sahip olduğunu gösterebilir.

**Anahtar kelimeler:** Güz tırtılı, ilk kayıt, yayılıcı tür, mısır, Adana, Türkiye.

ORCID ID (Yazar Sırasına göre)

0000-0002-9444-7457,0000-0001-7352-4815

Yayın Kuruluna Geliş Tarihi: 03.10.2022

Kabul Tarihi: 24.10.2022

<sup>1</sup>Çukurova University, Agricultural Faculty, Plant Protection Department, Adana, Türkiye.

\*E-posta: spehlivan@cu.edu.tr

# First record of the fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797) (Lepidoptera: Noctuidae) in Türkiye

## Introduction

Maize (*Zea mays* L.) which is originated in Central America is one of the major crops cultivated in the world after wheat and rice (Purseglove, 1992; Sandhu et al., 2007). While the annual maize production in the world is 1.16 billion tons, the USA is in the first place among the countries producing maize with an annual production of 360 million tons, China with 260 million tons, and Brazil with a production of approximately 90 million tons (FAO, 2020). Adana Province is one of the most important maize producer in Türkiye, contributes to the country's economy with approximately 800 thousand tons (TUIK, 2020). In Türkiye, the crambids *Chilo partellus* Swinhoe, *Ostrinia nubilalis* Hübner, (Lepidoptera: Crambidae) and the noctuid *Sesamia nonagrioides* Lefebvre (Lepidoptera: Noctuidae) are major maize stem borer pests, causing profound economic losses (Kayıpınar and Kornoşor, 1992; Sertkaya and Kornoşor, 2000; Achiri et al., 2020; Pehlivan and Atakan, 2021). During the random maize field surveys performed for stem borers, new lepidopteran larvae have been recorded on seriously damaged young maize plants probably swan animal feeding i.e. slaj. The field observed larvae were different from the recorded lepidopteran species; they were transferred to the laboratory for detailed diagnosis. The infested plants showed the typical damage symptoms caused by fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae). Moreover, the observed larvae has white inverted 'Y' on the front of the head and four black dots forming a square pattern on the eighth abdominal segment which are also basic characteristics of the fall armyworm larvae (FAO and CABI, 2019). *Spodoptera frugiperda* is known as a destructive and invasive pest that is indigenous

## Materials and methods

### Field survey

Following the first observation of the *S. frugiperda* larvae, surveys were carried out in Adana Province. Due to the end of the growing season only four fields were controlled. In each field, ten randomly selected plants at ten

to the tropical and subtropical regions of the Americas, and it has spread rapidly across more than 100 countries worldwide recently (Tsai et al., 2020). *Spodoptera frugiperda* is a highly polyphagous insect species that can feed on 353 plant species belong to 76 families mainly Poaceae, Asteraceae and Fabaceae. The larvae feed on leaves, stems and reproductive parts of various crops such as maize, rice, sorghum, sugarcane, some vegetables and cotton (Montezano et al., 2018). It is considered as the key pest of maize in Argentina, Brazil, Canada and Chile. In Brazil, *S. frugiperda* causes up to 34% reduction in maize grain yield and the amount of the annual loss reaches up to US\$ 400 million (Lima et al., 2010). Besides, it causes approximately US\$ 500 million in annual crop losses throughout the South-East United States and the Atlantic coast (Young, 1979). The adults have a high dispersal ability which sometimes can be extended to several kilometers (Cock et al., 2017). In the Americas, adult moths can travel hundreds of kilometers per night on prevailing winds from their endemic zone to the warm regions. The distribution of *S. frugiperda* was restricted in the American continents till 2015. Then, this invasive pest was reported for the first time in West Africa in 2016 (Goergen et al., 2016) and now it has spread rapidly to over 44 countries in Africa (Prasanna et al., 2018; Rwomushana et al., 2018). In the EPPO region, the first occurrence of *S. frugiperda* was in Egypt in 2019 (IPPC, 2019), while then in Southern Israel (IPPC, 2020a) and Jordan in 2020 (IPPC, 2020b), most recently in Syria (Heinoun et al., 2021). As far as we know there was no record from Türkiye up to now. With this study, the first report of *S. frugiperda* in Türkiye has been done based on morphological characters, and its damage to young maize plants.

different spots of the field, totally 100 plants, were inspected and its damage to plants was recorded. The infested maize plants were cut at ground level and then taken to the Entomology Laboratory, Çukurova University, Adana, Türkiye. The maize stalks were dissected and

**First record of the fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797)  
(Lepidoptera: Noctuidae) in Türkiye**

the larvae were recorded at species levels based upon its typical morphological characteristics.

**Morphological identification**

Field-collected samples were identified according to the larval and adult morphology. The larvae showed characteristic inverted white 'Y' mark on the head between the eyes (Figure 1A), more prominent thin white or yellowish lines develop down the length of the body (Figure 1A), light colored bands on the sides with a dark colored band between them (Figure 1B) and four large black dots in a square

formation on the 8th abdominal segment (Figure 1A) (Crumb, 1956; Levy and Habeck, 1976; FAO and CABI, 2019). The pupa is reddish-brown in color, measuring 14 to 18 mm in length (Figure 1C). The forewings of the females are less distinctly marked and colored ranging from grey to brown. The forewings of the males are shades of grey and brown with triangular white spots at the tip and near its center. The hindwings are straw color with a dark-brown margin in both sexes (Figure 2A-B; Luginbill, 1928; Sparks, 1979).

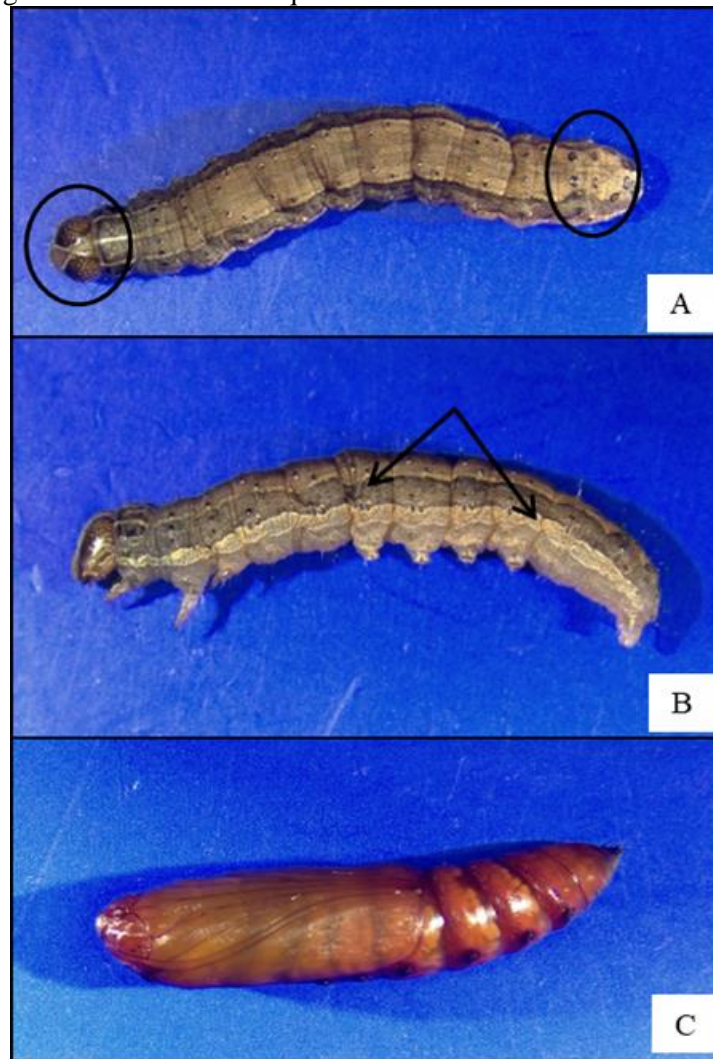


Figure 1. Mature larva dorsal (A), lateral (B) view and pupa (C)

**First record of the fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797)  
(Lepidoptera: Noctuidae) in Türkiye**



Figure 2. Adult female (A) and male (B) of *Spodoptera frugiperda*

**Results and Discussion**

**Distribution of the *S. frugiperda* in Adana**

Field-collected samples were positively identified as *S. frugiperda* based on larval morphology. Due to the end of the growing season in Adana Province, only four fields were controlled and all of them were infested with *S. frugiperda* larvae and few larvae of *C. partellus* (Figure 3).

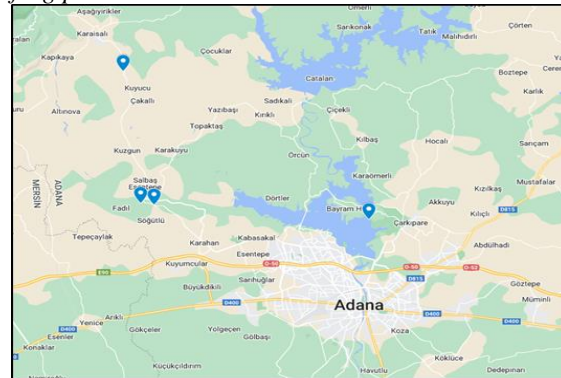


Figure 3. Infested maize fields with *Spodoptera frugiperda* in Adana Province

**Damage status and infestation rates of *Spodoptera frugiperda* in Adana**

The infestation rates of maize plants with *S. frugiperda* and *C. partellus* were between 14-18% in different districts of Adana province (Table 1). *Spodoptera frugiperda* was found all fields and the density of larvae of that pest varied between 4 to 14. Larvae cause damage by consuming leaf tissue from one side, leaving the opposite epidermal layer intact (Figure 4A).

Feeding in the maize whorl often produces characteristic holes of perforations in the leaves (Figure 4B). Due to the cannibalistic behavior of *S. frugiperda*, one to two larvae per plant could be found. Larvae also show typical damage by tunneling into the growing point (bud, whorl, etc.) and thus, it is destroying the growth potential of plants (Figure 4C) and causing dead heart damage.

Table 1. Rates of infected plants with *Spodoptera frugiperda* in Adana Province

Sampling dates	Coordinates	Sampling location by districts	Rate of damaged plant (%)	Total number of <i>Spodoptera frugiperda</i>	Total number of <i>Chilo partellus</i>	Total number of larvae
19.09.2022	37°04'53.2"N 35°20'42.9"E	Sarıçam	14	14	0	14
28.09.2022	37°05'39.2"N 35°07'23.3"E	Çukurova	15	9	0	9
28.09.2022	37°05'49.7"N	Çukurova	18	4	9	13

**First record of the fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797)  
(Lepidoptera: Noctuidae) in Türkiye**

	35°06'40.5"E					
28.09.2022	37°13'22.7"N 35°05'31.7"E	Karaisalı	16	7	17	21
-	-	Adana	-	34	26	60



Figure 4. Damaged maize plants (A-C) and mature larva (D) of *Spodoptera frugiperda*.

Following the first report of *S. frugiperda* in Africa in 2016, this invasive pest has been detected more than 50 countries in Africa and Asia continents. The high migration capacity of adults, its wide host range, high fecundity, and cannibalistic ability of mature larvae to dominate interspecific competitors could increase the survival possibility of this pest when it colonizes a new area (Goergen et al., 2016, Bentivenha et al. 2017; Tsai et al., 2020).

*Spodoptera frugiperda* larvae are reported to feed on more than 350 plants species. The larvae can cause major damage and destroy a wide variety of vital crops such as maize, rice, sorghum, sugarcane and cotton (Montezano et al., 2018). In Türkiye, there was no record up to now. During the maize field surveys for pest such as stem borers, it was detected for the first time in Türkiye. Its damage was quite similar to the other maize stem borers, especially *C. partellus* which was found on the 2 fields together. *Spodoptera frugiperda* larvae can cause damage to all developmental stages of maize plants. Marengo et al. (1992) reported that the late whorl stage was the most sensitive to its damage. Besides, they noted that mean densities were 0.2 to 0.8 larvae per plant during the late whorl stage; yield reduction can reach up to 20 percent. With this study, 14-15% damage has been determined in maize fields due to the fall armyworm larvae in Adana

(Table 1). As a detrimental pest, *S. frugiperda* may have a considerable damage potential to cause yield loss with infestation rates ranging between 15 and 73% in many staple crops (Day et al. 2017). In Brazil, *S. frugiperda* causes up to 34% reduction in maize grain yield and the amount of the annual loss reaches up to US\$ 400 million (Lima et al., 2010). Day et al. (2017) reported that average crop losses can reach up to 45% in Ghana and 40% in Zambia.

*Spodoptera frugiperda* cannot enter diapause warm regions where host plants are regularly suitable, and temperatures are not dropped below 9.9 °C (Luginbill, 1928). In many parts of Asia and Africa, the ideal climatic conditions for *S. frugiperda* is present, and the pest can produce 4-6 generations in a year due to the abundance of available host plants. In 2022, it has been recorded that the mean temperature is 9.5°C even in the coldest winter month January in Adana Province which is located in the Eastern Mediterranean Region of Türkiye (Anonymous, 2022). This shows that this invasive pest may reproduce progeny and spread almost throughout the year without entering diapause, and it may have a great potential becoming a major pest of maize in the insect-infested locations. We can conclude that *S. frugiperda* has newly introduced to Türkiye. For this reason, further works on such as its geographical distribution, suitable host plants,

**First record of the fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797)  
(Lepidoptera: Noctuidae) in Türkiye**

damage status and potential natural enemies soon possible.

**References**

- H., Chareonviriyaphap, T., Chiang, M. Y., Lin, P.A. et al. (2020). Rapid identification of the Achiri, T. D., Atakan, E., Pehlivan, S. (2020). Seasonal fluctuations and development of degree-day models for *Chilo partellus* (Lepidoptera: Crambidae) in maize fields in the Mediterranean region. *Eur J Entomol* 117: 68-75.
- Anonymous 2022. Meteoroloji Genel Müdürlüğü İklim Verileri. <https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=ADANA>. Erişim tarihi: 20 Eylül 2022.
- Bentivenha, J. P., Montezano, D. G., Hunt, T. E., Baldin, E. L., Peterson, J. A., Victor, V. S., Pannuti, L. E. R., Vélez, M., Paula-Moraes, S. V. (2017): Intraguild interactions and behavior of *Spodoptera frugiperda* and *Helicoverpa* spp. on maize. *Pest Manag Sci* 73(11): 2244-2251.
- Cock, M. J. W., Beseh, P. K., Buddie, A. G., Cafa, G., Crozier, J. (2017). Molecular methods to detect *Spodoptera frugiperda* in Ghana, and implications for monitoring the spread of invasive species in developing countries. *Sci Rep* 7(1):1-10.
- Crumb, S. E. (1956). The Larvae of the Phalaenidae. Technical Bulletin No. 1135. Washington DC, USA: United States Department of Agriculture.
- Day, R., Abrahams, P., Bateman, M., Beale, T., Clotey, V., Cock, M., ... & Witt, A. (2017). Fall armyworm: impacts and implications for Africa. *Outlooks on Pest Management* 28(5): 196-201.
- FAO, 2020. Food and Agriculture Organization of the United Nations Statistics. <http://www.fao.org/faostat/en/#data/QC> Erişim tarihi: 20 Eylül 2022.
- FAO and CABI (2019). Community-Based Fall Armyworm (*Spodoptera frugiperda*) Monitoring, Early warning and Management, Training of Trainers Manual, First Edition. 112 pp.
- Goergen, G., Kumar, P. L., Sankung, S. B., Togola, A., Tamò, M. (2016): First report of outbreaks of the fall armyworm *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera, Noctuidae), a new alien invasive pest in West and Central Africa. *Plos One* 11(10): e0165632.
- Heinoun, K., Muhammad, E., Abdullah Smadi, H., Annahas, D., & Abou Kubaa, R. (2021). First record of fall armyworm (*Spodoptera frugiperda*) in Syria. *EPPO Bull* 51(1): 213-215.
- IPPC (2019). Report of first detection of *Spodoptera frugiperda* – Fall Armyworm (FAW) in Egypt. In IPPC Official Pest Report. FAO, Rome (IT).
- IPPC (2020a). Report of first detection of *Spodoptera frugiperda* – Fall Armyworm (FAW) in Israel. In IPPC Official Pest Report. FAO, Rome (IT).
- IPPC (2020b). Report of first detection of *Spodoptera frugiperda* – Fall Armyworm (FAW) in Jordan. In IPPC Official Pest Report. FAO, Rome (IT).
- Kayapınar, A., Kornoşor, S. (1992). Çukurova'da *Ostrinia nubilalis* Hübner (Lep.: Pyralidae)'in doğal düşmanlarının saptanması ve en etkili olan yumurta parazitoidi *Trichogramma evanescens* Westwood (Hym. Trichogrammatidae)'in yayılış alanının belirlenmesi. Türkiye II. Entomoloji Kongresi, 28-32 Ocak, ADANA.
- Levy, R., Habeck, D.H. (1976). Descriptions of the larvae of *Spodoptera sunia* and *S. latifascia* with a key to the mature *Spodoptera* larvae of the eastern United States (Lepidoptera: Noctuidae). *Annals of the Entomological Society of America*, 69(4):585-588.
- Lima, M. S., Silva, P. S. L., Oliveira, O.F., Silva, K.B., Freitas, F.C.L. (2010). Corn yield response to weed and fall armyworm controls. *Planta Daninha* 28(1):103-111.
- Luginbill, P. (1928). The Fall Armyworm. USDA Technical Bulletin 34. 91 pp.

**First record of the fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797)  
(Lepidoptera: Noctuidae) in Türkiye**

- Management: differences between conventional and organic farming systems.
- Marengo, R. J., Foster, R. E., Sanchez, C. A. (1992). Sweet corn response to fall armyworm (Lepidoptera: Noctuidae) damage during vegetative growth. *J Econ Entomol* 85(4): 1285-1292.
- Montezano, D.G., Specht, A., Sosa-Gomez, D.R., Roque-Specht, V.F., Sousa-Silva, J.C., Paula-Moraes, S.V. et al. (2018). Host plants of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) in the Americas. *African Entomol* 26:286–300.
- Pehlivan, S., Atakan, E. Adana İlindeki Mısır Üretim Alanlarında Zararlı Mısır Kurtlarının (Lepidoptera: Crambidae, Noctuidae) Yaygınlık Durumunun Belirlenmesi. *Çukurova Tarım ve Gıda Bilimleri Dergisi* 36(1): 71-80.
- Prasanna, B.M., Huesing, J.E., Eddy, R., Peschke, V.M. (2018). Fall armyworm in Africa: A guide for integrated pest management. CDMX: CIMMYT.
- Purseglove, J. W. (1992). Tropical Crops: Monocotyledons. Longman Scientific and Technical, New York. 300-305.
- Rwomushana, I., Bateman, M., Beale, T., Beseh, P., Cameron, K., Chiluba, M., Clotey, V., Davis, T., Day, R., Early, R., Godwin, J., Gonzalez-Moreno, P., Kansime, M., Kenis, M., Makale, F., Mugambi, I., Murphy, S., Nunda, W., Phiri, N., Pratt, C., Tambo, J., 2018. Fall armyworm: impacts and implications for Africa. evidence note update, October 2018. 53pp. Available at: <https://www.invasive-species.org/wp-content/uploads/sites/2/2019/02/FAW-Evidence-Note-October-2018.pdf>.
- Sertkaya, E., Kornoşor, S. (2000). Çukurova’da Mısır koçankurdu, *Sesamia nonagrioides* Lef. (Lepidoptera: Noctuidae)’in Doğal Düşmanları. Türkiye 4. Entomoloji Kongresi, 12-15 Eylül, Aydın, 339-348.
- Sandhu, K. S., Singh, N., Malhin, N. S. (2007). Some properties of corn grains and their flours I: Physicochemical, functional and hapatti-making properties of flours. *Food Chem* 101: 938-946.
- Tsai, C.L., Chu, I.H., Chou, M. invasive fall armyworm *Spodoptera frugiperda* (Lepidoptera, Noctuidae) using species-specific primers in multiplex PCR. *Sci Rep* 10(1):1-8.
- TUİK, 2020. Türkiye İstatistik Kurumu, Tahıllar ve diğer bitkisel ürünlerin alan ve üretim miktarları. <https://biruni.tuik.gov.tr/medas/?kn=92&locale=tr> Erişim tarihi: 20 Eylül 2022.
- Young, J. R. (1979). Fall armyworm: control with insecticides. *Florida Entomologist*, 130-133.