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Appearance of Fall Armyworm, *Spodoptera frugiperda* as A New Invasive Insect Pest on Maize Plants in the Nile Delta, Egypt

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ABSTRACT



Spodoptera frugiperda (Lepidoptera: Noctuidae) is an insect pest that attacks many crops around the world and causing large reductions in the crop yield, including Graminaceous crops, especially maize. This pest introduced Egypt from Sudan, was recorded for the first time in Egypt in 2019 at Aswan Governorate on corn plants, and recently recorded in Assiut Governorate in 2021. In this study, the presence of *S. frugiperda* was detected in the Nile Delta of the northern part of Egypt, since it was transferred from the Upper Egypt governorates. Identification was made by observing the symptoms of infection on the investigated corn plants and the morphological characteristics of insect stages, such as holes on leaves and stems with larval feces, and presence of a white Y-shape on the head and 4 crescent-shaped black spots on all abdominal segments, except for the eighth segment, where they are square shaped. Further, the pupa has a pair of straight thorns at the end, while the adult insect has a row of small scales near the apical margin of the wing and the color of the wing changes from grayish brown to rusty brown. This study proves the presence *S. frugiperda* in northern part of Egypt, and because this pest has been detected, identified and its dispersal and crop destruction has been confirmed in many governorates of Egypt, it is necessary to update the geographical maps of its local distribution, to apply the recommended control approaches as a way to minimize its impacts on the agricultural crops. Further studies on its biology, host range, and food preference have to be taken in account.

Keywords: *Spodoptera frugiperda*, Corn plant, northern Egypt.

INTRODUCTION

The fall armyworm (FAW), *Spodoptera frugiperda* (Lepidoptera: Noctuidae) is a polyphagous pest that feed on 353 host plant species belonging to 76 plant families such as Asteraceae, Fabaceae and Graminaceae (Montezano *et al.*, 2018 and Huang *et al.*, 2020), and native to the tropical and sub-tropical regions of the West and South of America (Otim *et al.*, 2021). FAW does not have the ability to diapause (Du Plessis *et al.*, 2020), so it spreads constantly in search of its plant hosts in areas far from the severe cold (Huang *et al.*, 2020). It has a strong dispersal ability, for example, in China, it was first discovered in January 2019 in the Chinese city of Yunnan, and by the end of 2019 it has been recorded in 1524 Governorate in 26 provinces, with an area of 1,125.33 hectares. Further, in recent years and because of the globalization of trade, this pest has moved to many other continents (Huang *et al.*, 2020). It was first recorded in Africa in 2016 (Goergen *et al.*, 2016 and Sisay *et al.*, 2018), and within three years, the insect invaded 47 African countries (Wan *et al.*, 2021). This pest entered to Egypt from Sudan and was recorded for the first time in Egypt on corn plants in 2019 in a village of Kom-Ombo city, Aswan Governorate (Dahi *et al.*, 2020), then it dispersed to invade Luxor, Qena, Sohag and recently Assiut Governorate in 2021 (Mohamed *et al.*, 2022).

Maize is the preferred host for *S. frugiperda* in the countries where it has been recorded. It can reduce the annual production of corn by 21-53% in the absence of control methods (Huang *et al.*, 2020). FAW has a high ability to spread to new areas and the lack of its vital natural

enemies have led to significant risks to food security and the livelihoods of many small farmers for maize crop in Upper Egypt, which is the most important cereal crop in Africa including Egypt (Mohamed *et al.*, 2022).

Therefore, it is necessary to predict the early infestation of the FAW to prevent its risks and take advantages of this in an integrated pest management approach. This study further gives another report of the early detection of this serious insect pest on maize crops at Kafr El-Sheikh, El-Beheira and Al-Qalyubia Governorates, Nile Delta, Egypt.

MATERIALS AND METHODS

The study was carried out through field visits to maize fields (*Zea maize*) in five regions belonging to three Governorates in the Nile Delta, Egypt during June, July and August 2022 as follows: (region1: Monshaat El-Shazly, Qillin, Kafr El-Sheikh Governorate 31.056, 30.771", region2: Kafr Al-Shahawi, Desouk, Kafr El-Sheikh Governorate "31.057, 30.759", region3: El-Bostan, El-Delengat, El-Beheira Governorate "30.755, 30.539", region4: Housh Eissa, El-Beheira Governorate "30.905, 30.286", region5: Moshtohor, Touch, Al-Qalyubia Governorate" 30.357, 31.221" and region6: Al-Shubak, Shibin El-Qanater, Al-Qalyubia Governorate "30.303, 31.323" and region7: Qaha, Al-Qalyubia Governorate "30.281, 31.223") Figure (1), Google Maps was used to locate these regions.

In each region, representative maize-producing districts were surveyed for collecting FAW *S. frugiperda*

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larvae from maize plants and transferred to the biological studies laboratory in the Faculty of Agriculture at Moshtohor, Benha University, Egypt. After that, these larvae were provided with maize seedling for feeding until they transferred into the pupal stage and then into adults, to

determine the morphological characteristics of the different stages of the FAW *S. frugiperda* “larva, pupa and adult” to confirm that it is, and use them in future studies to conduct biological and toxicological studies and conduct food preference tests for this pest.



Figure 1. Geographical google map of a part of Nile Delta showing the regions where the FAW was confined in a) Kafr El-Sheikh Governorate (Qillin and Desouk), b) El-Beheira Governorate (El-Delengat and Housh Eissa) and c) Al-Qalyubia Governorate (Toukh, Qaha and Shibin El-Qanater) surrounded in red.

RESULTS AND DISCUSSION

After field inspections on maize plants in three governorates, Kafr El-Sheikh, El-Beheira and Al-Qalyubia, FAW was identified firstly by its damage symptoms then by larval morphological characteristics, the appearance of FAW damage identified on maize plants on the previous 7 regions which belonging to the three governorates in the Nile Delta, Egypt during June, July and August 2022 (region1: Monshaat El-Shazly, Qillin, Kafr El-Sheikh Governorate, region2: Kafr Al-Shahawi, Desouk, Kafr El-Sheikh Governorate, region3: El-Bostan, El-Delengat, El-Beheira Governorate, region4: Housh Eissa, El-Beheira Governorate, region5: Moshtohor, Touch, Al-Qalyubia Governorate, region6: Al- Shubak, Shibin El-Qanater, Al-Qalyubia Governorate and region7: Qaha, Al-Qalyubia Governorate). Based on field observations, the FAW infestations were recorded on all maize growth stages (seedling – flowering – filling – maturity stage) as it eats leaves, stalks, cobs, kernels and tassels as well as it will be mentioned later.

Field infestation and Symptoms:

The infestations and symptoms of this pest were detected as follows; presence of the caterpillar in the heart of the seedling stage (Fig. 2a), presence of adults between the stalk and leaf (Fig. 2g), watching egg patches on of the leaves (Fig. 2h and i), elongated patches on leaves in the form of irregular spots as a result of feeding the larvae (Fig. 2b), holes in corn stalk surrounded by sawdust-like larva feces (Fig. 2c and d), erosion in the newly formed tassels (Fig. 2f), corrosion in the cobs and its ears, silks and soft grains (Fig. 2e). These same symptoms are presented by Capinera (2020) who indicted that FAW larvae can burrow into corn stalk and sometimes burrow into the ear, feeding on kernels in the same manner as corn earworm, *Helicoverpa zea*. These symptoms are also similar to those reported by Navasero *et al.* (2019), CABI, (2019) and Sartiami *et al.* (2020). The symptoms reported in this study are also confirmed with those identified on different other crops in many countries (FAO, 2018; Ganiger *et al.*, 2018; Chormule *et al.*, 2019).

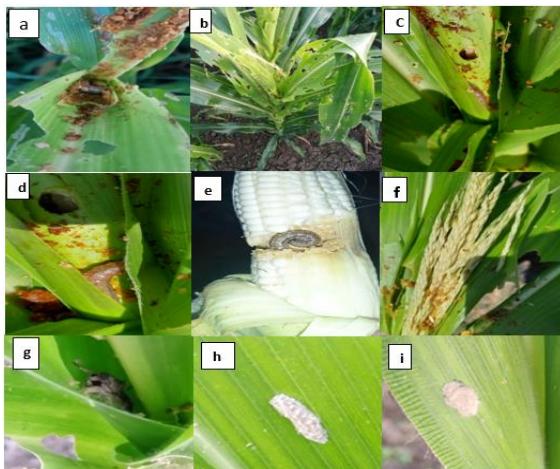


Figure 2. Symptoms of *Spodoptera frugiperda* larvae on maize plants; larva of FAW on the heart of maize seedling (a), maize plant completely damaged by the fall armyworm (b), a big hole on the maize stalk by last larval instar of FAW (c and d), destroyed maize cob by larva of FAW (e), infested tassel of maize plant (f), adult of *S. frugiperda* hidden between leaves (g), and egg patches of FAW on maize leaves (h and i).

Identification and confirmation of *S. frugiperda*

After collecting *S. frugiperda* larvae from maize fields, these larvae were examined and defined depending on its main characteristics, young larvae are greenish or brownish with white longitudinal stripes (Fig. 3a, b and c) and they are about the same size as *S. littoralis* young larvae, while the last 3 instars were noticed with color variation from green to dark brown (Fig. 3d and e). The distinctive

morphological marks of *S. frugiperda* appears when the larvae examined closely as the mature larva face is marked with a white inverted "Y" (Fig. 3f) and the cuticle of the larva is rough in texture, 4 large black spots arranged in a square on the 8th abdominal segment and 4 small black dots with half-circle shape "crescent-like structure" on the dorsal surface of all other segments (Fig. 3e and f). The fully grown larva of *S. frugiperda* is about 30 (Pogue, 2002) to 40 mm in length (EPPO, 2004) and have a color variation, ranging from pinkish, through yellowish, olivaceous, brown, dull grey to almost black (Pogue, 2002). The dorsal pinacula on 8th abdominal segment are large and have a typical arrangement: on segment 8 they are arranged in a square shaped, on segment 9 in a trapezoid (OEPP/EPPO, 2015).

After collecting the different larval instars from the maize fields and bringing them to laboratory of biology on the Plant Protection Department, creating the appropriate conditions for larvae rearing and providing them with sufficient food (maize seedlings) until they transformed into the pupal stage, which characterized by a pair of straight thorns at the end, unlike the cotton leaf worm which has two twisted thorns (Fig. 3g and h). The distinction between male and female on the basis of the morphological whole of each, and it has been proven that they are females and males of the fall armyworm. *S. frugiperda* males the forepart of the forewings is generally shaded gray-brown, with white triangular spots at the tip of the wing and near its center, while the forewings of females are less conspicuous than males, and range from regular grayish-brown to fine gray-brown spotting. The hind in both sexes wing is iridescent silvery white with dark narrow borders.

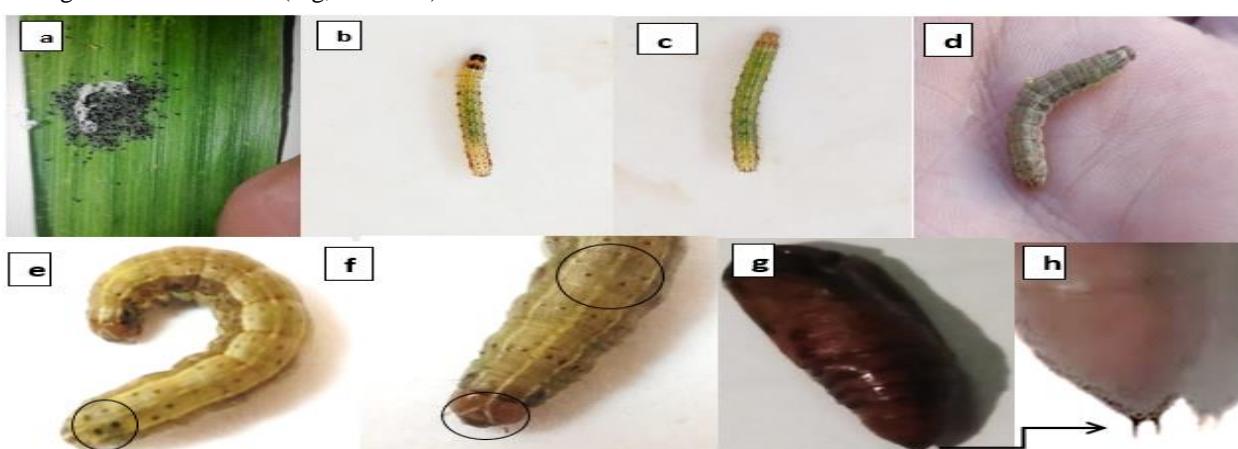


Figure 3. Young larvae of *S. frugiperda* (a, b and c), last larval instars of the fall armyworm with 4 crescent-shaped black spots on abdominal segments, except for the eighth segment where they are square shaped (d and e), an inverted white Y-shape on the head capsule of the larva (f), and pupa of FAW that has a pair of straight thorns at the end of the body (g and h).

CONCLUSION

After this pest has been detected, identified and its dispersal and crop destruction has been confirmed in many governorates of Egypt, it is necessary to update the geographical maps of its local distribution, to apply the recommended control approaches as a way to minimize its impacts on the agricultural crops. Further studies on its biology, host range, and food preference have to be taken in account.

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ظهور دودة الحشد الخريفية *Spodoptera frugiperda* على نباتات الذرة في دلتا النيل، مصر

هدير شوقي عبدالله راشد ، مها سعيد خليل ، كمال ماهر خلوى و إبراهيم عبدالسميع الغباوى

قسم وقاية النبات - كلية الزراعة - مشتهر - جامعة بنها- مصر.

الملخص

دودة الحشد الخريفية (*Spodoptera frugiperda* Lepidoptera: Noctuidae) هي آفة حشرية تهاجم العديد من المحاصيل في جميع أنحاء العالم وتتنسب في انتشارها إلى غلة المحاصيل، بما في ذلك المحاصيل التجبلية، وخاصة الذرة. تم تسجيل هذه الآفة التي دخلت مصر من السودان، لأول مرة في مصر عام 2019 في محافظة أسوان على نباتات الذرة، وتم تسجيلها مؤخراً في محافظة أسيوط في عام 2021. في هذه الدراسة، تم اكتشاف وجود *S. frugiperda* في دلتا النيل في الجزء الشمالي من مصر، حيث انتقلت من محافظات الصعيد. تم التعرف من خلال ملاحظة أعراض الإصابة على نباتات الذرة التي تم فحصها والخصائص المورفولوجية لمراحل الحشرات، مثل التغوب على الأوراق والسبقات مع برار البرقات، وجود شكل حرف Y أبيض على الرأس و 4 بقع سوداء على شكل ملال على جميع حلقات البطن مادعا الحلقة الثامنة حيث تكون مرتبعة بشكل علامة على ذلك، تحتوي العذراء على زوج من الأشواك المستقيمة في نهايتها، بينما تحتوي الحشرة البالغة على صفات المقياس الصغيرة بالقرب من الحافة القمية للجناح ويتغير لون الجناح من النبي الرمادي إلى النبي القاتم. ثبتت هذه الدراسة وجود *S. frugiperda* في الجزء الشمالي من مصر، وأن هذه الآفة قد تم اكتشافها والتعرف عليها وتؤكد انتشارها وتدمير المحاصيل في العديد من محافظات مصر، فمن الضروري تحديث الخرائط الجغرافية لتوزيعها المحلي. لتطبيق مناهج المكافحة الموصى بها كطريقة لتقليل أثارها على المحاصيل الزراعية. يجب إجراء المزيد من الدراسات حول بيولوجيتها ونطاقها العولىي وتقديرها الغذائي في الاعتبار.