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The fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae); first report of new invasive pest in maize fields of Gujarat, India

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Abstract

A study was conducted to identify the new invasive pest infesting maize in Gujarat, India. During the survey conducted in the month of September 2018, sweet corn field in the Ankav village of Anand district found infested with new invasive pest. Larvae were collected and brought to the laboratory of Department of Entomology, B. A. College of Agriculture, Anand Agricultural University, and Anand for identification and further study. Based on morphological and molecular characterization, the pest is identified as fall armyworm, *Spodoptera frugiperda* (J. E. Smith) and it is the first confirmed report of occurrence of new invasive pest in maize fields of Gujarat, India.

Keywords: Maize, invasive pest, fall armyworm, *Spodoptera frugiperda*

1. Introduction

Maize is an important food grain as well as fodder crop grown in different districts of Gujarat viz., Panchmahal, Dahod, Mahisagar, Vadodara, Chhotaudepur, Arvalli, Sabarkantha, Banaskantha etc. It is grown in about 3, 13, 000 ha with a production of 4,55,000 tonnes and productivity of 1455 kg/ha in Gujarat state^[1]. A new invasive pest, fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) is recently reported in Karnataka, Tamilnadu and Telangana infesting maize crop^[2, 5, 6]. Based on current status of pest in other states of India and its invasive nature, fast dispersal behaviour, survey work was carried out by a team of scientists of Anand Agricultural University, Anand during September, 2018 to study the occurrence of fall armyworm in Gujarat State.

2. Materials and Methods

During the survey in Anand district of Gujarat, sweet corn field located in Ankav village showed distinguished damage symptoms. The damaged plants were showing characteristic shot hole with ragged leaf symptoms. Developing cobs were also damaged with typical symptoms of fall armyworm damage. As the larvae observed were different from known lepidopteran species, they were brought to the laboratory of Department of Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand for detailed observation. The larvae were reared in the laboratory and all the stages viz., egg, larva, pupa and adult were critically examined for distinct morphological characters to identify the pest^[4].

Molecular characterization study was conducted at Department of Animal Biotechnology, College of Veterinary Science and Animal Husbandry, AAU, Anand. Larvae were used for DNA extraction. Genomic DNA was isolated by using DNA extraction kit (HIMEDIA Hipur ATM Insect DNA Purification Kit, Cat. MB529, India). PCR amplification of COI (cytochrome oxidase subunit I) gene was performed by following the standard protocol^[3]. Primers used for amplification were: forward primer (LCO1490 5'-GGTCAACAAATCAT-AAAGATATTGG-3') and reverse primer (HCO2198 5'-TAACTTCAGGGTGACCAAAAAATCA-3'). The amplified products were sequenced by capillary sequencer ABI-3130. Gene sequence was checked for homology by using NCBI-BLAST.

3. Results and Discussion

Fall armyworm incidence was noticed in a sweet corn field located in Ankav village, Anand District, Gujarat on 20th September 2018. Maize plants damaged by the larvae showed

Characteristic shot holes on the leaves. Grown up larvae were found confined to whorls and feeding between the leaves showing distinctive symptom of ragged appearance. A mass of faecal matter accumulated within the whorl. Larvae feeding on developing cob as well as silk were also noticed (Fig. 1). Larvae observed were different from known lepidopteran species infesting maize crop. In laboratory larvae were reared till adult stage, adults were allowed to mate and in the next generation all the stages were examined in detail.

3.1 Egg

Mass of eggs deposited in layers on underside of leaf. Eggs are creamy white covered with greyish colored scales (Fig. 2-A)

3.2 Larva

First instar larvae were light greenish colour with black head. The mature larvae were marked with whitish inverted 'Y' on the head with distinct black spots (pinacula) on the body. The

four black spots on the 8th abdominal segment were arranged in a square and on the 1 to 7th and 9th segment arranged in a trapezoidal pattern (Fig. 2-F). Grown up larvae were dark brown with granular texture all over the body. All the larval characters noticed were resembled those of *S. frugiperda* [4].

3.3 Pupa

Reddish brown in colour with cremaster (Fig.2-H&I)

3.4 Adult

Greyish brown male adults; forewings grey and brown shaded with oval or oblique orbital spots, triangular white patch near apical margins of the forewing (Fig. 2-J). In female adults, forewings lack distinct markings with uniform greyish brown mottled colouration [5, 6]. We had also received culture from Rajkot and Amreli districts of Gujarat and morphological features of larvae resembled with above mentioned distinct characteristics of *S. frugiperda*.

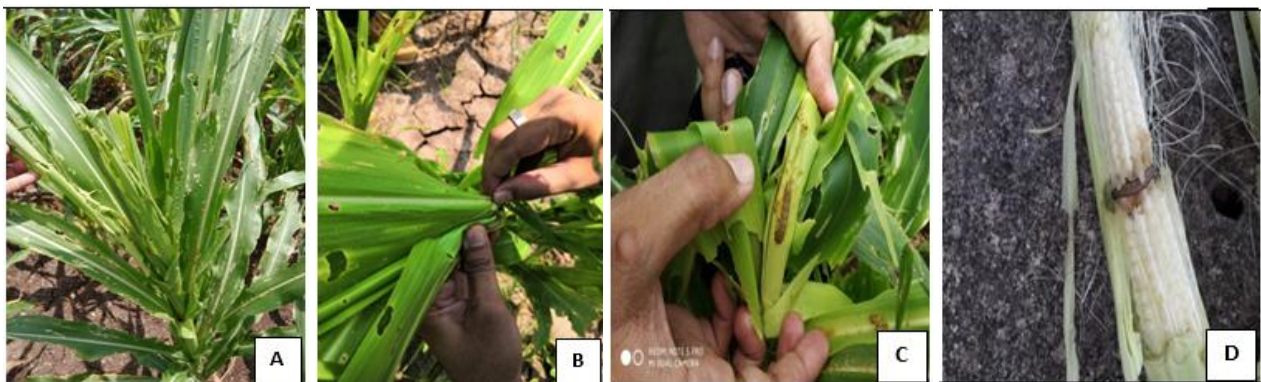


Fig 1: Different damage symptoms of *S. frugiperda* in maize field A. Ragged and elongated holes on leaves B. Shot hole symptoms on the outer leaves C. Larva feeding inside the whorl with fecal matter D. Larva feeding on the cob

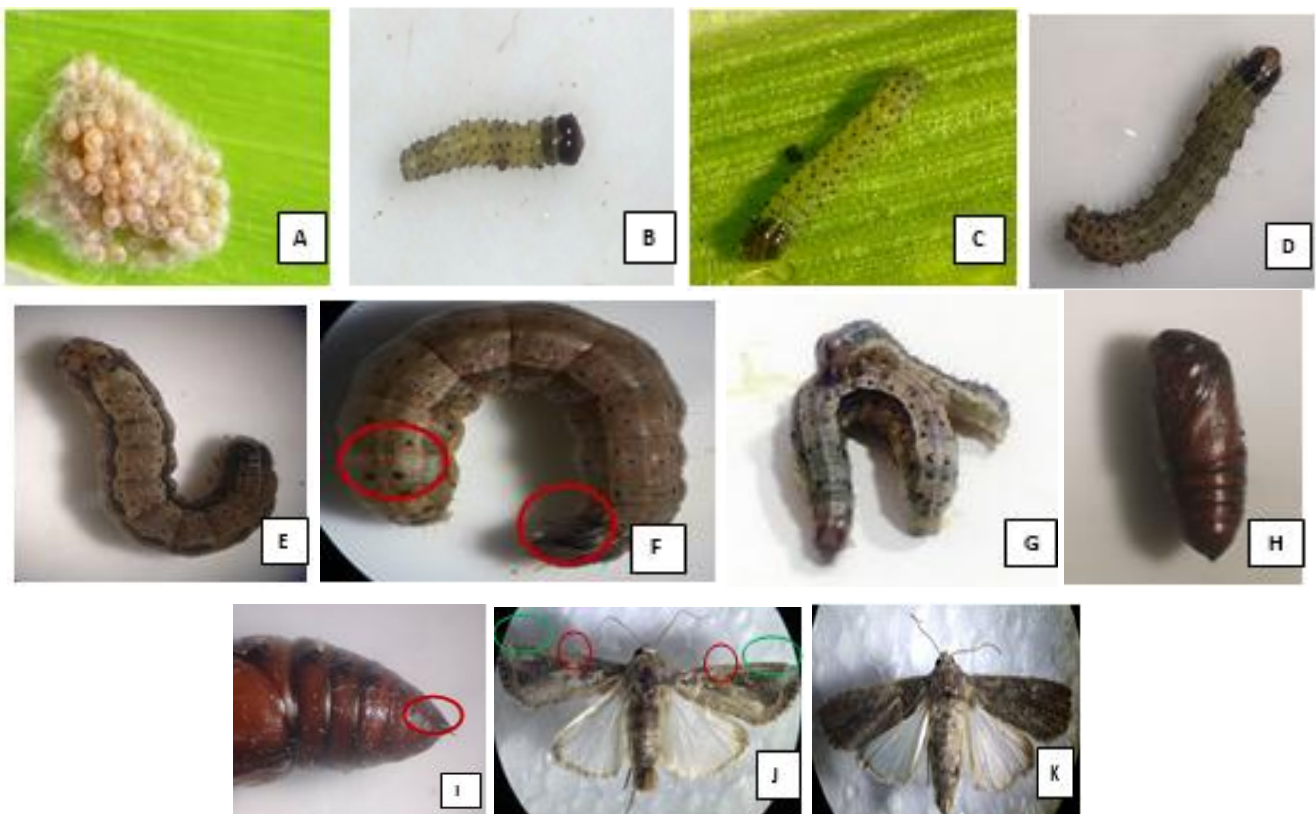


Fig 2: Life stages of fall army worm *S. frugiperda* A. Egg mass, B-E. Different larval instars, F. Raised four black spots on 8th abdominal segment and inverted 'Y' on head of fully grown larva, G. Cannibalism behavior in larval stage, H. Pupa, I. Pupa with cremaster, J. Adult male – triangular white patch near apical margin of forewing with oval orbital spots, K. Adult female forewing with mottled coloration of grey and brown

3.5 Molecular characterization

The Ankav population showed 99% resemblance with the database sequences of *S. frugiperda* (Accession No. MH190446.1, MH190444.1 & MH197867.1) from NCBI-Genbank. The consensus sequences of COI have been deposited in NCBI Genbank database (Accession No. MK034861).

Spodoptera frugiperda COI gene sequence (Anklav population)

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AATTTGACCCTGGAATTTAGACCGGGACTAGTAGGTAC
TTCTTTAGGTTGTATTAATTCGAGCTGAATTAGGAACTC
CAGGATCTTTAATTGGAGATGATCAAATTTATAATACT
ATTGTAACAGCCCATGCTTTTATTATAATTTTTTTTATA
GTTATACCAATTATAAATTGGAGGATTTGGAAATTGACT
TGTACCTTTAATATTAGGAGCTCCTGATATAGCTTTCCC
ACGTATAAATAATATAAGTTTTTGACTTTTACCCCATC
TTTAACTTTTATTAATTTCTAGTAGCATTGTAGAAAATGG
AGCAGGAACTGGATGAACAGTTTACCCCCCTCTCTCT
CTAATATTGCTCATGGTGGTAGTTCAGTAGATTTAGCTA
TTTTCTCACTTCATTTAGCTGGAATTCATCTATTTTAGG
AGCTATTAACCTTTATTACCACTATTATTAATATACGATT
AAATAATTTATCATTTGATCAAATACCTTTATTTATTTG
AGCTGTAGGTATTACCGCATTTTTTATTATTATTATCTTT
ACCTGTTTTAGCTGGAGCTATTACTATATTACTTACTGA
TCGAAATCTAAATACATCATTTTTTCGATCCTGCAGGAG
GAGGTGATCCTATTCTTTATCAACATTTATTTGATTTTT
TGGTCACCGGGAAGTTAAAAGT
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4. Conclusion

The findings of morphological and molecular characterization studies endorse the species as *S. frugiperda* and this is the first confirmed report of invasive pest the fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) in maize fields of Gujarat State, India. Although, the pest is recorded in maize crop, looking to its host range and migration ability it may spread to other crops viz., sorghum, pearl millet, rice, cotton, vegetables etc.

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