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FIRST RECORD OF FALL ARMYWORM *SPODOPTERA FRUGIPERDA* (J. E. SMITH) (LEPIDOPTERA: NOCTUIDAE) DAMAGE TO POTATO: A POTENTIAL PEST OF THE CROP IN PAKISTAN

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ABSTRACT

The recent introduction of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) into Pakistan has resulted in millions of dollars of losses for maize production. Due to the wide host range, high fecundity, and long-distance migrations favoring fall armyworm establishment, it has the potential to cause significant damage to several crops in Pakistan. In the maize cropping system, potato is another important crop that is cultivated on vast hectares. Okara is considered as the hub of both maize and potato production in Pakistan. The existence of fall armyworm on maize could possibly threaten the potato crop. To ascertain the extent of possible damage from fall armyworm, we conducted a comprehensive survey of the potato growing area of the Okara District, Punjab, Pakistan. We collected twelve larvae from potato damaged plants from three different locations lat. 30.813979°, long. 73.533934°; lat. 30.725032°, long. 73.730319° and latitude 30.646966°, long. 73.786563°. Collected larvae were identified as fall armyworm. The plants from which the larvae were collected, have a visible single hole at the base of the stem, which resulted in a sudden decline of feeding tiller. To our knowledge, this is the first report of fall armyworm occurrence and its damage on potato crop in Pakistan.

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INTRODUCTION

Recent introductions of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae), into the African continent (Goergen *et al.*, 2016; Day *et al.*, 2017; Stokstad, 2017; Devi, 2018) and Asian continent (Sharanabasappa *et al.*, 2018; Ganiger *et al.*, 2018; Sisodiya *et al.*, 2018; Naeem-Ullah *et al.*, 2019; Gilal *et al.*, 2020) have caused extensive losses. Fall armyworm has been reported on more than 350 plant species including

maize, rice, cotton, sorghum, spinach, carrot, onions, garlic, pot marigold, and sugarcane (Murúa *et al.*, 2008; Barros *et al.*, 2010; Campos *et al.*, 2012; Devi, 2018; Montezano *et al.*, 2018; Prasanna *et al.*, 2018). Furthermore, its high fecundity (Sparks, 1979), long distance migrations (Rose *et al.*, 2012), and its wide host range (Devi, 2018), could allow caterpillar to survive throughout the year in suburban and urban ecosystems (Tepa-Yotto *et al.*, 2021).

In Pakistan, fall armyworm was first identified in Sindh on maize during the 2019 cropping season (Naeem-Ullah *et al.*, 2019) and has subsequently spread across the maize growing areas of Sindh and Punjab (Gilal *et al.*, 2020; Khan *et al.*, 2020). Maize is considered the third most important crop after wheat and rice in Pakistan (Majeed and Muhammad, 2018). Sixty-nine percent of the total production of maize is contributed by Punjab (Tariq and Iqbal, 2010).

During the cropping season 2021, fall armyworm has caused extensive losses to the maize crop at the 3-5 leaf as well as at the cob stage (Gilal *et al.*, 2020). Potato is another important crop of Pakistan and is mainly cultivated in the maize cropping system. Potato growing areas, including Okara, Sahiwal, Pakpattan, Kasur, Gujranwala, and Sheikhpura, contribute 96% of potato production in the national economy (Hussain, 2019; Zafar *et al.*, 2020). To ascertain fall armyworm occurrence on potato, as a new potential pest, we conducted a comprehensive survey for caterpillars on potato in the Okara District, a major maize-potato growing area of Punjab, for possible occurrence and damage to the potato crop.

MATERIALS AND METHODS

The Okara District is considered as hub of potato and maize production (Butt *et al.*, 2008). During 2020, maize in the region was severely affected by fall armyworm (Personal observations). Because of fall armyworm's polyphagous habits, high fecundity, and adaptability, a field survey was conducted in areas where potato was planted at the end of September after maize harvesting. We concentrated the survey in those fields where potato foliage was about 30 cm above ground level. Potato fields were thoroughly searched for any damaged leaves, dead or nearly dying plants, and stressed plants, for possible infestation. Plants thought to be infested were brought back to the Insect Plant Interaction Laboratory, University of Agriculture, Faisalabad, sub campus Depalpur, Okara, Pakistan.

Field samples were carefully examined with the naked eye as well as under a stereomicroscope (IRMECO). Live caterpillars collected from damaged potato plants from these field collections were carefully examined and larvae were identified using Passoa (1991). Collected larvae were also released on potted potato plants for confirmation of their damage in the laboratory ($27\pm 1^{\circ}\text{C}$, $65 \pm 5\%$ relative humidity and 16:8 (L:D) photoperiod).

RESULTS AND DISCUSSION

A total twelve larvae were found from three different potato fields in the Okara District (lat. 30.813979° , long. 73.533934° ; lat. 30.725032° , long. 73.730319° and lat. 30.646966° , long. 73.786563°). The collected larvae (3rd and 4th instars) were identified as *Spodoptera frugiperda*, the fall armyworm (Figure 1). Caterpillars have a brownish to reddish head capsule with a pale-colored upside-down Y-shaped suture. They are marked with a series of green, brown, black, or reddish colored stripes that run parallel along the body. The dorsum of each abdominal segment is marked with two pair of dark-colored marks, from which setae arise, and four large black dots in square form on second last abdominal segment (Todd and Poole, 1980; Pogue, 2002) (Figure 1).

In the field, fall armyworm damage can be easily distinguished from another insect damage (Figure 2). A visible single hole at the base of the stem is a very characteristic feature of fall armyworm damage. The larvae remain inside the stem, feeding on the stem tissues (Figure 2). We have not found any excreta in the feeding stem, with a possibility that the larvae were not fully entered into the stem portion while observing the potato in the field (Figure 2). Collected larvae identified as fall armyworm were also released on potted potatoes to confirm their feeding. The larvae feed on the stem (Figure 3), and ultimately causes the sudden decline of the potato feeding tiller (Figure 3). The potential for significant damage to potato is alarming for growers, policy makers, and managing authorities. Due to the availability of its host plant, maize, during spring and autumn, fall armyworm can establish extensively in the cropping system (Figure 4). The potato season that comes right after harvesting maize in the autumn provide an opportunity for fall armyworm to establish (Figure 4). The recent observations of fall armyworm occurrence and damage on potato crop requires immediate attention by farmers, agricultural regulators, and researchers to address the fall armyworm situation and devise timely management strategies to avoid a significant threat to national food security and the livelihood of farmers.

CONCLUSION

To our knowledge, this is the first report of damage to potato caused by fall armyworm. A detailed study on the demographic parameters needs to be conducted to

understand the feeding biology more completely, as well as the damage potential of fall armyworm on potato and other crops, including vegetables, grown in or near potato fields. Sustainable management techniques must be developed. If control measures are not properly implemented, there is the potential for significant economic damage by this pest to potato production in Pakistan. In addition, according to Day *et al.* (2017),

governments of countries with fall armyworm populations should promote awareness, identification, damage potential, and control as soon as possible, as well as give emergency/temporary registration for appropriate insecticides. Without understanding its present distribution and clarifying its biological parameters in this new environment, an adequate management strategy cannot be developed.

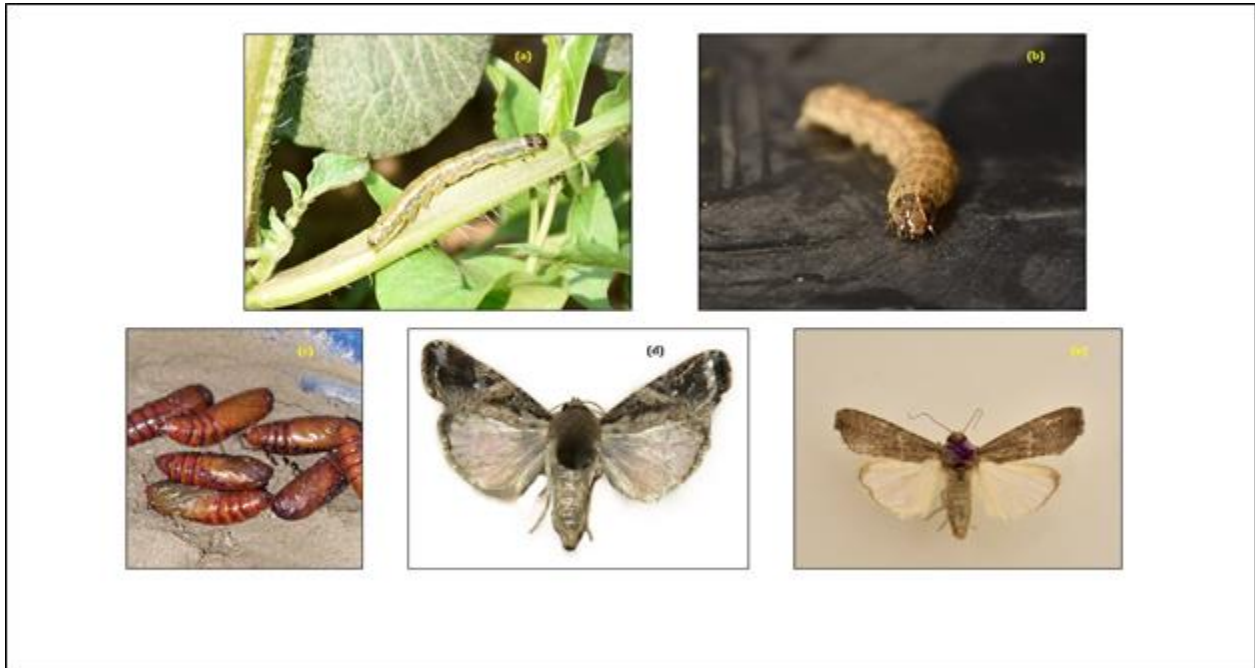


Figure 1. Fall armyworm larvae (a & b), pupa (c), and emerged adults (male(d); female (e) from field collected damaged potato plants.

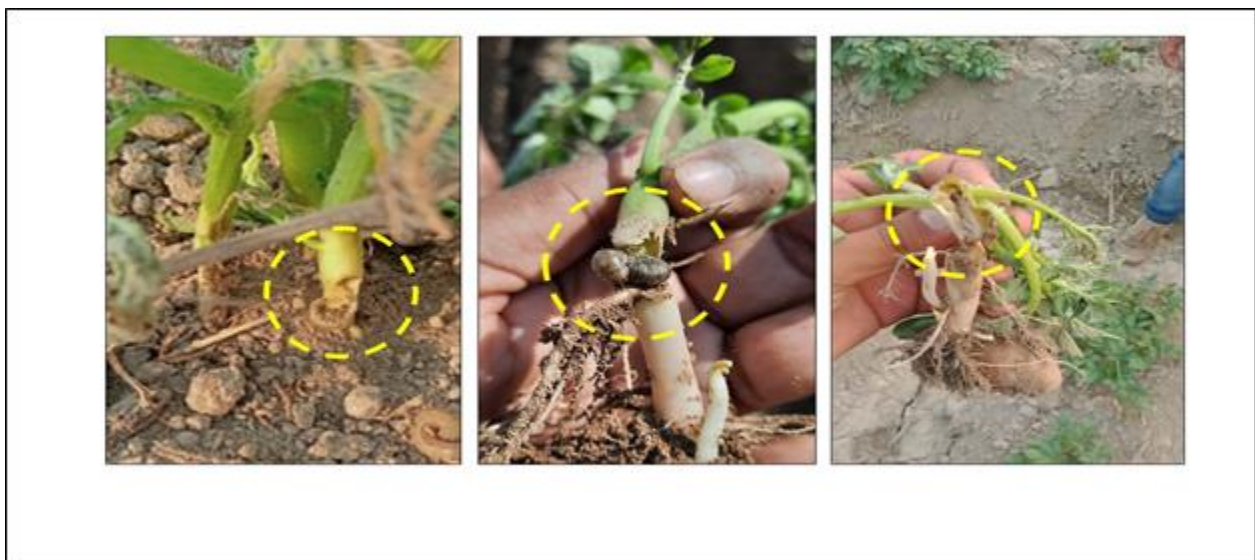


Figure 2. Fall armyworm damage to potato plants in potato field.

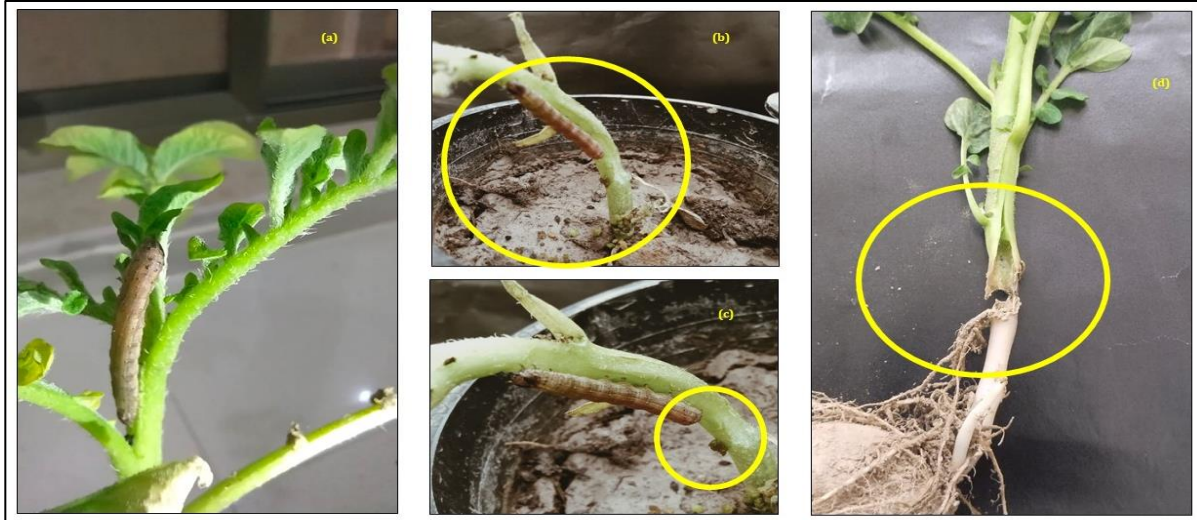


Figure 3. Fall armyworm larvae feeding on potato plant (a), feeding damage and frass (b & c), and visible symptoms of fall armyworm damage to potato (d).

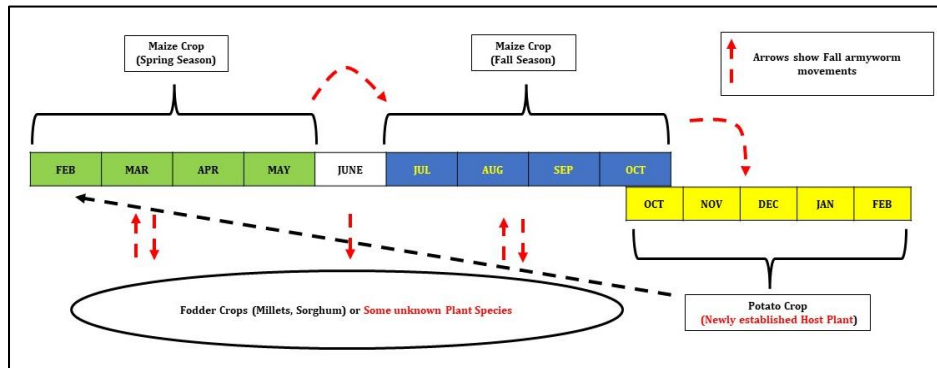


Figure 4. Seasonal gap (white box) between the maize spring and autumn crop and availability of potato crop (yellow boxes) bridging host for resident fall armyworm and possible migration to maize spring crop.

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