



Predicting climate change impacts on potential worldwide distribution of fall armyworm based on CMIP6 projections

Maruthadurai Ramasamy¹ · Bappa Das² · R. Ramesh¹

Received: 27 January 2021 / Revised: 12 July 2021 / Accepted: 13 July 2021

© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2021

Abstract

The fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith), is a highly destructive insect pest of several crop plants and threatening global food security. The current Coupled Model Intercomparison Project phase 6 (CMIP6) data set was analysed to predict the potential worldwide distribution of FAW under present and future climate change scenarios in 2050 and 2070 under Shared Socioeconomic Pathway (SSP) 1-2.6 and SSP5-8.5 emission scenario with 19 bioclimatic variables through maximum entropy (MaxEnt) niche modelling. The MaxEnt model predicted the potential distribution of *S. frugiperda* with area under the receiver operator curve (AUC) values of 0.915 and 0.910 during training and testing, respectively. Annual precipitation, annual mean temperature and isothermality were the strongest predictors of *S. frugiperda* distribution with 42.6%, 22.4% and 10% contributions, respectively. The recent CMIP6 models predicted higher suitability of FAW in North America, Africa and Asia under future climatic conditions. Global suitability of FAW is predicted to increase by 4.49% and 8.33% under SSP1-2.6 and SSP5-8.5 scenarios, respectively, compared to that of current climate conditions. Multimodel ensemble predicted the highest risk of invasion and spread of FAW by 2050 and 2070 under SSP5-8.5 scenario. The predictions could be used to forecast the potential spread of FAW and combating outbreaks well in advance. Our results will be an important guide for researchers, policymakers and governments to devise suitable management strategies against this highly invasive pest.

Keywords Invasive pest · *Spodoptera frugiperda* · Invasion · Global spread · Forecasting · Modelling

Key message

- Predicted worldwide distribution of FAW using current and CMIP6 future climate scenarios.
- Annual precipitation and annual mean temperature play a key role in the distribution of FAW.
- Highest risk of invasion and spread of FAW predicted under SSP5-8.5 climate change scenario.

- Predictions could be used to monitor and forecast the potential distribution of FAW.

Introduction

The fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith), is a highly voracious insect pest indigenous to the American continents. It is a serious pest of maize and other crops in many countries and threatening global food and fodder security. It causes annual crop losses of over US\$ 500 million in South-East USA and the Atlantic coast (Young 1979). In the absence of effective control, the pest inflicts severe economic damage and yield losses valued from 2531 to 6312 million US dollars annually in 12 maize-growing countries of Africa (Day et al. 2017). FAW is known to feed on over more than 353 plant species but prefers to feed more on Gramineae family (Montezano et al. 2018; Casmuz Augusto et al. 2010; Maruthadurai and Ramesh 2020). Until 2015, the pest was restricted to the

Communicated by Antonio Biondi.

✉ Maruthadurai Ramasamy
duraiento@gmail.com

¹ Crop Science Section, ICAR (Indian Council of Agricultural Research), CCARI (Central Coastal Agricultural Research Institute), Ela, Old Goa, Goa 403402, India

² Natural Resource Management Section, ICAR (Indian Council of Agricultural Research), CCARI (Central Coastal Agricultural Research Institute), Ela, Old Goa, Goa 403402, India