Harnessing data science to improve integrated management of invasive pest species across Africa: An application to Fall armyworm (Spodoptera frugiperda) (J.E. Smith) (Insecta: Lepidoptera: Noctuidae)

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Abstract

Fall armyworm (FAW), Spodoptera frugiperda (J.E. Smith) threatens maize, sorghum, and millet production in Africa. Despite rigorous work done to reduce FAW prevalence, the dynamics and invasion mechanisms are still poorly understood. This study applied interdisciplinary tools, analytics, and algorithms on a FAW dataset to provide insights and projections on the intensity of FAW infestation across Africa. The data collected between January 2018 and December 2020 were matched with the monthly average data of the climatic and environmental variables. The multilevel analytics identified the key factors that influence the dynamics of spatial and temporal pest density and occurrence at a 2 km x 2 km grid resolution. The seasonal variations of the identified factors and dynamics were used to calibrate rule-based analytics employed to simulate the monthly densities and occurrence of the FAW for the years 2018, 2019, and 2020. Three FAW density level classes were inferred, i.e., low (0–10), moderate (11–30), and high (>30). Results show that monthly density projections were sensitive to the type of FAW host vegetation and the seasonal variability of climatic factors. Moreover, the diversity in the climate patterns and cropping systems across the African sub-regions are considered the main drivers of FAW abundance and variation. An optimum overall accuracy of 53% was obtained across the three years and at a continental scale, however, a gradual increase in prediction accuracy was observed among the years, with 2020 predictions providing accuracies greater than 70%. Apart from the low amount of data in 2018 and 2019, the average level of accuracy obtained could also be explained by the non-inclusion of data related to certain key factors such as the influence of natural enemies into the analysis. Further detailed data on the occurrence and efficiency of FAW natural enemies in the region may help to complete the tri-trophic

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