A systematic methodological approach to estimate the impacts of a classical biological control agents dispersal at landscape: Application to fruit fly Bactrocera dorsalis and its endoparasitoid Fopius arisanus.

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Abstract

Following the invasion of Africa by the oriental fruit fly, Bactrocera dorsalis, Classical biological control (CBC) have been exploited as a safer alternative for its suppression by the introduction and release of the koinobiont endoparasitoid, Fopius arisanus. Although, the parasitoids have been released in several African countries, its extent of dispersal resulting in numbers of beneficiaries fruit growers has not yet been elucidated. This paper proposes an innovative multi-level CBC impact analysis combining cellular automata (CA) and ecological niche models to estimate parasitoid dispersal ranges and household beneficiary populations. Firstly, we provide a generic systematic methodological approach using CA rules incorporated into species distribution. Secondly, the model was used to estimate the dispersal range of the parasitoid based on the life history and bioecology of the host insect (fruit fly) and the parasitoid. Finally, the parasitoid dispersal coverage was mapped across fruit crops attacked by the target fruit fly, and the number of households that have benefitted from the parasitoids release programme was extracted from the area of the dispersal (first in Kenya), and the data was projected across all countries where the parasitoid have been released and validated. In Kenya, the model showed that F. arisanus had covered a total area of 50.34 km2 from the initial point of open field release; and at the continental scale, the model predicted that the parasitoid had covered a total area of 229.97 km2. The model estimated that 351,855 and 3,731,330 households have directly benefited from the release of F. arisanus between 2013 to 2018 in Kenya and at the continental level, respectively. The study's outcome is appropriate for providing feedback information on the impact of CBC to government and development partners to make informed decisions on technological interventions.

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