Geometric- morphometric and genetic study of Olive fly (*Bactrocera oleae* (Rossi): Tephritidae), an invasive pest, in Iran and other world distribution regions

Mitra Moezipour1*, Jamasb Nozari2, Parvaneh Azmayesh fard2 and Konstantinos D. Mathiopoulos3

1Department of Plant Protection, Agricultural and Natural Resources Research Center of Mazandaran. P. O. Box. 48175-556, Sari, Iran
2Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran
3 Department of Biochemistry & Biotechnology, University of Thessaly, 26 Ploutonos Str., 41221 Larissa, Greece

*Corresponding author: moezipour@ut.ac.ir

ABSTRACT

*Bactrocera oleae* is the main insect pest of olive fruits. During the last 15 years, the olive production area has increased more than tenfold in Iran reaching to more than 120,000 hectares today. Surprisingly, the olive fly, was a quarantine pest and had not been reported until July 2004. Field-collected flies from different localities, were analyzed to investigate their morphological and genetic variations based on geometric morphometric and microsatellites. Geographic populations of olive flies were collected from eight locations from three provinces in Iran (Guilan, Qazvin and Zanjan), that this pest is established. In addition to the flies collected in Iran, flies also were collected from the US (California), South Africa, occupied Palestine and Mediterranean basin. The wing shape and size of flies was compared among geographic populations using geometric morphometric. 14 landmarks were selected on wing and the shape of it was compared among populations by using multivariate analysis on the partial warps. Relationships between geographic populations were investigated which led to the population clustering through UPGMA. Results support the notion of a morphological differentiation of four groups including flies from the US (California), the European part of the Mediterranean basin, Iran (except Manjil) and Occupied Palestine and Manjil (Iran) - South Africa. The geometric morphometric analysis showed significant variations ($F= 7.756, p=0.000$) among total geographic populations and also Iranian populations separately. Also, Olive flies from different regions, genotyped by using of eight microsatellite markers. These loci were highly polymorphic with a mean number of alleles per locus of 9.75 and a mean effective number of alleles of 2.64. Results of UPGMA method support the notion of a differentiation of four subpopulations including Iran, Mediterranean basin, occupied Palestinian and South Africa. Small $F_{st}$ values for Iranian samples show that these samples cluster together, forming a quite homogenous group. This cluster is clearly closely related to the Mediterranean populations of the species.

Key words: *Bacterocera oleae*, population structure, Geometric morphometric, geographic populations, SSR