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Honey bees (*Apis mellifera* L.) are bioindicators of environmental pollution levels. During their wide-ranging foraging activity, these hymenopterans are exposed to pollutants, thus becoming a useful tool to trace environmental contaminants like heavy metals, pesticides, radionuclides, and volatile organic compounds. It has been demonstrated that various environmental stresses, including both abiotic and biotic stresses, functioning singly or synergistically, are the potential drivers of colony collapse. All these factors can negatively impact bees' immune response as a key target for environmental stress factors, making them more susceptible to pathogens and parasites. Early diagnosis of factors predisposing to immunosuppression of colony mortality can facilitate rapid interventions to contain and prevent the spread of mortality. On this line of arguments, there is a wide demand for innovative technological solutions offering efficient and cost-effective monitoring of the honeybees' health. In this scenario, the project MoBeeFO, funded by the Italian Ministry of University and Research, proposes to develop an efficient tool based on fiber optic technologies for real-time monitoring the dynamic of honeybee's innate immunity mediated by various biotic and abiotic stressors. In particular, MoBeeFO will address a real-time measurement tool for detecting a cellular response, such as encapsulation index and melanization index along the surface of fiber optic transducers, as a nonself object, and a humoral response by developing of innovative optical fiber biosensor for antimicrobial peptide detection. The results will allow us to develop a unique niche in the field of Eco-Immunology that will be important for world agriculture and environment.