Project number	Project Title	Summary	Applicant requirements
1	Exploring the role of grasses and associated fungal species in oviposition site selection of malaria vector mosquitoes	The development of vector control and monitoring tools that target malaria mosquitoes outside houses and tools that are not insecticide-based have been prioritised by all major funding organisations and the World Health Organization to close the currently existing control gap (i.e. exophilic vector populations, insecticide resistant populations). Targeting oviposition site-seeking mosquitoes using odour cues would provide such a tool. Recent pioneering work implemented at *icipe* suggests that olfactory cues released from grasses, specifically grasses characteristic for wetlands, directly or indirectly through association with fungi might be used by gravid malaria mosquitoes in search for egg-laying sites. This project aims to investigate the relationship between swamp grasses, associated fungi and oviposition site selection of malaria vectors in the laboratory, semi-field and field. The PhD candidate will develop skills in medical entomology, behavioural and chemical ecology and microbiology.	MSc degree with distinction in Biological Sciences or related subject. A strong background in medical entomology and independent research experience is desirable. Basic microbiology skills would be beneficial. The project work will require modification of trapping tools and manual technical skills, and therefore imagination and creative ability are highly desirable.
2	Design of new tools for tomato protection against *Tuta absoluta* based on semiochemicals to reduce pest oviposition and to attract parasitoids/predators	Tomato, which is the most widely grown market garden crop in the world, is threatened by an invasive insect pest in Africa: *Tuta absoluta*. Currently, the most common method to control the pest is the application of pesticides. The development of effective control methods that reduce the reliance of pesticide use is a major goal and challenge for modern agriculture. Semiochemicals offer a new strategy for crop protection, although the semiochemicals that lead to *T. absoluta* attraction and oviposition on tomato are little known. This PhD project will investigate the chemical interactions between *T. absoluta*, the tomato plant and parasitoids/predators to design a new crop protection strategy. The project aims to identify the tomato volatiles that attract *T. absoluta* and the chemical cues that lead to oviposition behavior. Then the *T. absoluta* induced tomato volatiles will be identified and tested as repellents for *T. absoluta* and as attractants for its predator *Nesidiocoris tenuis* and one specific parasitoid.	MSc in Biology, with experience in insect sciences. A good command of the English language (written & spoken) is essential, and ability to also communicate in French would be an added advantage.
3	Pre- and post- release evalution of *Dolichogenidea gelechiidivoris* (Marsh) for suppression of *Tuta absoluta* (Meyrick)	Despite the socio-economic significance of tomato as a food and cash crop, its production in Africa is limited by numerous constraints. Ranking high among them is the invasion and widespread distribution of *Tuta absoluta* that has devastated tomato production and related industries. Alarmed at its devastating impact, tomoato growers in Africa have resorted to indiscriminate use of broad spectrum insecticides. This is likely to lead to the development of insecticide resistance. Being an alien invasive pest, it seems it is lacking an efficient resident parasitoid. A co-evolved and very promising parasitoid, *Dolichogenedia gelichidivoris,* was identified in Peru and its introduction into Kenya is planned. Therefore, this study aims to assess the performance of this parasitoid on *T. absoluta* and subsequent release for *T. absoluta* suppression. Also interaction with the indigenous parasitoid fauna and non-target effects will be evaluated. Furthermore, a follow-up assessment for establishment of this parasitoid in tomato agro-ecologies in Kenya and prediction of potential establishment in other African countries and globally will be undertaken.	BSc degree in Agriculture/Biological Sciences and MSc graduate in Agricultural Entomology preferred.

4	Identification of effectors and allelochemicals regulating root knot nematode parasitism	Root knot nematodes (RKN) are sedentary endoparasitic nematodes that infect the plant root system causing galls that inhibit plant nutrient and water acquisition for successful growth and development. The infective second stage juvenile (J2) must seek a host before its lipid reserves are depleted. The J2 produces secretions that act as effectors that weaken the plant defense systems in susceptible plants. In antagonistic plants such as the Asteraceous species, the roots produce allelochemicals that suppress parasitism of root knot nematodes. Recent studies at *icipe* have established that plant released compounds influence the host seeking behavior of RKN. This project aims to investigate the role of effectors and allelochemicals regulating root knot nematode parasitism in laboratory and screen house experiments. The PhD candidate will develop skills in chemical ecology, analytical chemistry and molecular biology.	MSc in Organic Chemistry and experience in spectroscopic methods. Previous experience working with nematodes will be an added advantage.
5	One Health approach to vector biology and arbovirus epidemiology in smallholder livestock systems	Emerging viral pathogens are of global public health concern, with novel and re-emerging pathogens encountered with increasing frequency. Many of these are zoonotic in nature, having an animal origin. This project will investigate the natural history of arthropod borne viruses (arboviruses) in domestic cattle, mosquito and tick vectors and (to a limited degree) in humans in western Kenya, where several viruses of medical and veterinary importance occur. These viruses are a constraint to both livestock production and human health. This project will be multidisciplinary, involving both laboratory-based entomological and disease identifications and epidemiological analyses. With a focus on vector ecology and virus epidemiology, the project will provide the candidate with important skills for research on emerging arboviruses and their transmission. The hypothesis is that virus transmission occurs in densely populated smallholder livestock production systems with domestic livestock as a reservoir community. Using molecular- and sero-surveillance approaches, the project will determine the most important vectors of zoonotic pathogens and their livestock reservoirs in this part of western Kenya, where a large diversity of potential arbovirus vectors have recently been identified and high sero-prevalence rates in humans have been detected. The study will capitalize on large-scale field activities funded by the UK BBSRC/ UK DFID.	MSc in Entomology, Molecular Biology, Virology or Immunology, with relevant experience in field epidemiology.
6	Development of effective biopesticides for management of pesticide resistant strains of whiteflies infesting vegetables in East Africa	Whiteflies such as *Bemisia tabaci* (Gennadius) and *Trialeurodes vaporariorum* (Westwood) are key constraints to productivity of vegetables such as tomato and French bean in Africa. Management of these pests are largely by use of pesticides, although with little benefit as whiteflies are highly resistant to various classes of pesticides. Cryptic feeding behavior of the pest and presence of cuticular waxes hinders access by contact pesticides resulting in high dependence on systemic insecticides with negative environmental effects. Entomopathogenic and endophytic fungal biopesticides targeting the adult and nympal stages of whiteflies can be effective alternatives to pesticides in the management of whiteflies. Efficacy of these biopesticides could be enhanced through development of potent formulation and innovative application strategies. This project will focus on identifying effective entomopathogenic and endophytic biopesticides, development of effective formulations and innovative application strategies for effective management of whiteflies infesting vegetables in the East Africa.	MSc in Crop Protection/Entomology or Applied Microbiology with specialisation in insect pathology

7	Development of biopesticides for below ground pest and nematode constraints of banana in East Africa	Banana contributes to the daily source of calories for more than one billion people globally and is a key food and export crop in Africa. Productivity of banana is often severely constrained by several below ground insect pests, nematodes and pathogens. Management of these constraints, if any, are largely pesticide based, while resource poor farmers often leave the crop unmanaged leading to severe yield losses. The root zones of banana provide an environment conducive for the activity of various beneficial microorganisms such as entomopathogenic fungi, nematodes and endophytic organisms. Such beneficial organisms hold potential to be developed as key components of pest management of below ground pests of banana. This project will focus on bioprospecting for potential biopesticides from the root zones of banana, assess their efficacy against key pests such as banana weevil and plant parasitic nematodes, assess systemic resistance induced by these biopesticides, assess the compatibility between the different biopesticides and pesticides to develop a microbial consortium that effectively targets multiple below ground pest constraints of banana.	MSc in Crop Protection/Entomology/Nematology or Applied Microbiology with specialisation in insect pathology
8	Epidemiology of coffee pathosystem in the smallholder context on the Aberdare range, Kenya: modeling the impact of agroecological factors for coffee pest and disease dynamic prediction	The very low level of coffee productivity observed in smallholder farmers of Kenya's Central Region is often explained by the poor implementation of good agricultural practices. The main objective of the present research is to contribute to the improvement of cropping recommendations for pest and disease (P&D) control on coffee. More specifically, the research will assess and map the main coffee P&D in Murang'a county on the Aberdare range. Models will be developed connecting P&D dynamics to relevant agroecological factors such as climate, microclimate, shade, land cover, farmer practices, soil and topography, in order (i) to explain the current P&D distribution and severity and (ii) to predict coffee pathosystem evolution during the coming decades according to the current climate change simulation. These models will help develop recommendations based on phytosanitary risk for a better management of coffee P&D on the Aberdare range.	The student should have basic skills in field work and should be able to quickly communicate with smallholder coffee farmers of Central Kenya (at least, the Kiswahili language is needed). Computer skills are critical and the student should be experienced in remote sensing, GIS tools and modelling.
9	Development of insect-based compost for sustainable soil health management using by-products from insect mass rearing for food and feed	Insects are increasingly being considered for use as food and feed worldwide. Indeed, recent studies have revealed that insect based feeds can outperform conventional feeds in livestock production. However, for insects to become a major protein source across Africa, millions of metric tons of dry insect material is required, which can only be achieved when considerable volumes of rearing substrates are used. Insects are reared on various wastes including livestock, industrial and farm organic wastes. The rapidly degrading soil quality across the continent, occasioned by decreasing soil organic matter and increasing soil acidification offers an opportunity for the use of waste from insect rearing for soil health improvement through promoting wide spread use of insect degraded substrates as soil amendment. The proposed study aims at developing and assessing the physical, chemical and microbial qualities of composts obtained through insect mass rearing as well as their performance on different crop and soil types for wider application.	MSc in Agronomy or Soil Sciences with some experience in soil fertility, soil microbiology and soil chemistry. Preferentially, with a BSc with a broader basis such as Agricultural Sciences.

10	Assessment of sand fly plant feeding behaviour in Baringo County, an endemic area for leishmaniasis and arboviruses in Kenya	Control of sand flies remains a priority as they pose a significant public health threat in many parts of the world, transmitting the agents of several zoonotic and parasitic diseases to humans. Efficient vectoring role of sand flies is enhanced by specific biological and behavioral characteristics that may be targeted by control measures to limit pathogen spread or vector abundance. This study will specifically examine sand fly plant feeding behaviour that is olfactory-driven and exploited for sugars and other metabolites. The hypothesis that selective utilisation of plants occurs in sand flies will be tested, focusing on selected species of Phlebotomus and Sergentomyia, with objectives to (1) identify host plant feeding sources in field trapped specimens; (2) evaluate the nutritional impact of the identified plants on sand fly survival; (3) isolate and identify odours they detect from the plants, and develop lures to maximise their attraction in field studies.	MSc in Medical Entomology/Organic Chemistry with experience in molecular biology.
11	Characterisation of unidentified mosquito-borne viral isolates and assessment of their public health potential	Arboviruses constitute an emerging public health threat, some of which are associated with human disease ranging from mild febrile illness to encephalitis and even death. Surprisingly, a majority of these infections is poorly diagnosed in Africa, which obscures the assessment of their potential impact on public health. Next generation sequencing (NGS) is increasingly being applied to identify viruses and even discover novel ones that are missed by conventional diagnostic methods such as serology, cell culture, or nucleic acid-based testing. This study will apply NGS to identify and characterise virus isolates from mosquito homogenates that could not be identified using conventional diagnostic methods. To gain insights into possible reservoirs or host range of these virus agents, growth kinetics on a range of cell lines from different species will be performed. Also, possible exposure of the viruses to humans will be assessed using archived serum samples collected from patients with febrile illness from areas where the viruses are detected. Significant insights that are important for risk assessment of arboviruses will be gained through this PhD project, plus the development of appropriate technologies for their diagnosis.	MSc degree with distinction in Biological Sciences or related subject. A strong background in medical entomology/virology and exposure to bioinformatics is desirable.
12	Development of microbe-based strategies for improved bee health	Pollinators, including honeybees, have a major impact on food security worldwide. Their significant population decline, often linked to phenomenon known as colony collapse disorder (CCD), has been raising alarm worldwide. CCD has been linked to numerous biotic and abiotic environmental changes. There is increasing appreciation for the role of symbiotic microbes in adaptation to novel environmental conditions. So-called “infectious adaptation” involves the acquisition of novel traits from novel hosts and occurs much more rapidly than “classical” Darwinian evolution. Bee gut microbiota play an important role in many aspects of bee biology and health. They are known to be important for digestion and protection against parasites. By investigating gut microbial diversity and the nature of specific interactions between microbes and bee fitness, we plan to lay the foundations for microbe-based strategies for improved bee health management. With the obtained data we plan to: (1) Guide the development of probiotics for increased hive resistance; (2) Gain a better understanding of the distribution of bee diseases and improved risk mapping.	Knowledge of insect physiology, microbiology, and molecular techniques (qPCR, HRM, PCR, 16S sequencing). Experience in Next Gen Sequencing technique and data analysis is an advantage. Soft skills: motivated, energetic, perseverant and problem solving oriented.

13	Analysing the possibility to monitor Striga weed infestation levels in eastern Africa using space-borne and *in situ* time-series observations	The value of maize lost due to Striga is at least US$ 1.2 billion each year. Small-scale farmers are mostly affected, especially if fields are left uncontrolled and Striga infestation occurs together with other productivity constraints. Striga weed infestation can be controlled with the push-pull technology. Push-pull is a simple cropping strategy that simultaneously addresses a number of key constraints of cereal–livestock mixed production systems in Africa, including the parasitic weed Striga. To have the most impact, push-pull must be widely adopted at Striga infestation 'hot spot' sites and containment areas. This study will investigate remote sensing tools and landscape scale modelling tools to map the abundance and distribution of Striga weeds in Kenya and Tanzania. The landscape study will specifically investigate the use of very high-resolution space-borne sensors to monitor the flowering Striga signal and plot level texture related to Striga infestations. The created explicit data sets will be used in the regional upscaling of the push-pull technology to priority areas.	Knowledge and practical experience in geo-spatial data analysis, GIS and remote sensing, statistics, crop sciences and agronomy