Eligible projects (ARPIS-DAAD Scholarships 2016)

#	Project Title	Summary	Applicant requirements
1	Characterization of nutritional, therapeutic and anti-nutritive factors associated with selected edible insects in East Africa	The consumption of the cricket (*Acheta domesticus*), longhorn grasshopper (*Ruspolia differens*) and saturniid caterpillar (*Gonoimbrasia zambesina*) is common among communities in East Africa. Edible insects are nutritious, with high contents of fats, protein, vitamins, fibre and minerals. Insects could also be sources of unique therapeutic molecules. Although some data on nutritive and anti-nutritive factors of edible insects are available from Asia and America, to date there has been little research carried out on edible insects in Africa. This PhD study will focus on characterisation of nutritive, therapeutic and anti-nutritive factors associated with unprocessed, processed and stored edible insect products in Africa. Various analytical chemical techniques including high performance liquid chromatography, liquid chromatography coupled to mass spectrometry (MS) and gas chromatography coupled to MS and chemical derivatization will be used to characterize these factors. The findings from this research will contribute to the establishment of quality standards for edible insect based products in Africa.	MSc in Human/Animal Nutrient/Analytical Chemistry with an entomology background.
2	Understanding the bioecology of edible grasshoppers in East Africa for development of improved rearing and harvesting techniques	In East Africa, consumption of the long-horned grasshopper (*Ruspolia differens),* tree locust (*Anacridium melanorhodon), Acanthacris* and other grasshoppers, contribute to food and nutritional security. Communities collect them through wild harvesting, which is seasonal and unreliable. Efforts to rear these insects are scarce or lacking. Also, information on bio-ecological factors influencing their abundance such as host plants, seasonality, weather, diapauses and diseases/natural enemies are lacking. Understanding these factors is essential to develop improved rearing and harvesting techniques for these edible grasshoppers to enhance their availability. The PhD study will include field ecological assessments on edible grasshoppers, molecular assessment of their gut contents to assess host range, and optimization of rearing conditions and quality parameters. The research outcome will contribute to underpinning science on edible insects and establishment of improved rearing and harvesting	MSc in Entomology/Plant Protection with experience in insect ecology and insect rearing.

		techniques in Africa.	
3	Towards understanding the role of push-pull cropping system in management of mycotoxins in maize in East Africa	One of the most significant constraints to the realization of food and nutritional security in sub-Saharan Africa is grain yield loss caused by insect pests and diseases. Ear rots, caused by fungi, are the most important diseases of maize since the fungi produce toxic substances, known as mycotoxins, including aflatoxins, which cause various diseases in humans and animals. It is estimated that about 40% of grain losses in SSA are due to these toxic substances. Research has demonstrated that incidence of ear rots correlates strongly with insect pest damage on the grains, and poor soil health. Therefore, cropping systems that help manage insect pests and improve soil health may potentially contribute to the management of ear rots in maize. Preliminary results suggest significant reductions in incidence and severity of mycotoxins with the push-pull cropping system (www.push-pull.net), particularly aflatoxins and fumonisins. This PhD study will build on these preliminary results, elucidate any underlying mechanisms for exploitation within and beyond maize protection, and establish relevant pathways to extend this knowledge to millions of farmers and stakeholders in the cereal value chain in the region.	In addition to a MSc in a relevant subject, the candidate should possess skills in the area of plant pathology and agronomy/soil science that includes biology or chemistry. Practical experience in these fields, including microbiological procedures, such as ELISA and PCR, and experience working with fungi is desirable.
4	Genetic diversity and spatio-temporal patterns of distribution of Huanglongbing (HLB) disease and its vector in Ethiopia and Uganda	Huanglongbing (HLB) is a serious disease of citrus species worldwide, largely associated with the near collapse of the citrus industry in Sub Saharan Africa (SSA). In SSA the disease is transmitted by the vector *Trioza erytreae*. Although *T. erytreae* causes some direct damage on leaves, it is most importantly known for transmission of the phloem-limited bacterium *Candidatus* Liberibacter africanus (CLaf), the principal cause of HLB. In recent years, another bacterium *Candidatus* Liberibacter asiaticus (CLas) has been reported in Ethiopia and Uganda. Hitherto, CLas was known only to be transmitted by the Asian citrus psyllid, *Diaphorina citri* in Asia, North America and Brazil. Despite this complex of bacterium causing HLB, the genetic diversity of the vector populations and their role in disease transmission in Ethiopia and Uganda are unknown. Some citrus psyllid populations may also have inherently differential ability to transmit HLB, and certain types and strains of citrus greening bacteria may be inherently more transmissible than others. This project, therefore, seeks to unravel the population genetic structure of the citrus psyllid in different agro-ecological zones of Ethiopia and Uganda to provide information that would aid in the	BSc in Agriculture/Biological Sciences, MSc in Agricultural Entomology or Plant Pathology.

		development of an integrated pest management approach to control HLB in Africa.	
5	Identification of chemical cues from *Oecophylla longinoda* repellent for fruit flies	In Africa, mango trees are important component of people's livelihood and contribute to food security via dietary diversity. However they are heavily damaged by several fruit fly species that are also quarantine pests in many parts of the world, including the European Union and the USA, threatening export markets. To control fruit flies in the mango orchard, farmers usually spray chemicals and harvest the fruits before maturity. Actually, reaching a satisfactory level of control using pesticide-free methods is a major challenge for modern agriculture. Recent studies have highlighted the weaver ant, *Oecophylla longinoda,* as a key generalist enemy to reduce fruit fly outbreaks. A theoretical hypothesis is that the fruit fly mother can find the highest quality oviposition site for larval fitness (i.e. for food quality and an enemy-free space). A recent review showed four out of five ant species that were tested deposit pheromones that repel herbivorous prey from their host plants. We hypothesize that *O. longinoda* deposits a trail pheromone that is repellent for fruit flies species. This PhD project will investigate the chemical interactions between *O. longinoda* and fruit flies, and identify the *O. longinoda* repellent semiochemicals against fruit flies. We propose to artificially produce the semiochemicals, and through the use of diffusers to increase repulsion of fruit flies in orchards and stimulate predation behavior.	MSc in Biology or other relevant subject and experience in entomology.
6	Analyzing the possibility to monitor Striga weed infestation levels in eastern Africa using space-borne and in situ time-series observations	The annual value of maize lost due to striga is at least US$ 1.2 billion. Small-scale farmers are mostly affected, especially if fields are left uncontrolled and parasitic striga weed infestation occurs together with other productivity constraints. Infestation of maize by striga can be controlled by the push-pull technology (www.push-pull.net). This PhD study will investigate remote sensing tools and ecological niche modelling tools (regional scale) to map the abundance and distribution of striga weeds in Kenya and Tanzania, which will help to identify areas where push-pull should be implemented. The landscape study will specifically investigate the use of very high-resolution space-borne sensors to monitor the flowering striga signal. The created explicit data sets will be used as reference data in the regional scale modelling of striga occurrence.	MSc in environmental science and engineering or programming (R programmers preferred). A focus on GIS an remote sensing is preferred but not essential.
7	Chemo-ecological mechanisms underlying	Lepidopteran female oviposition choices are guided by infochemicals from	MSc in Ecology, Entomology or

	oviposition choice in stemborers	infesting stages (eggs or larvae) from other conspecifics, which serve to adjust population sizes to available resources with a preference for un-infested plants. However, recently, our group discovered that females of maize stem borer moths preferentially oriented towards volatile organic compounds (VOCs) emitted by both conspecific- and heterospecific-infested plants compared to their uninfested plant counterparts. These results suggested that conspecific- or heterospecific- larvae-infested maize plants either produce or elicit specific chemical signatures, which signal optimum suitability of the infested host plant to female moths. This PhD project proposes to study and unravel the chemosensory mechanisms involved in uni- and multi-species stem borer infestations using standard chemical ecology techniques. It is hoped that the knowledge generated from this study will lead to the development of female biased kairomonal traps.	Biology with experience in insect related research or with experience in ecology or agronomy. A strong foundation and experience in statistical analysis is desirable. The successful candidate will have good oral and written communication skills.
8	Climate change mitigation through improved soil health; carbon sequestration and nitrogen fixation under the push-pull technology as a case study	The use of Desmodium spp., perennial fodder legumes, in the push-pull system (www.push-pull.net) has ramifications for the resilience of cropping systems though impact on soils and nutrient cycling while reducing greenhouse gas emissions. Desmodium fixes atmospheric nitrogen to the soil and helps conserve soil moisture. It adds organic matter, enhancing the capacity of the soil to sequester carbon. Preliminary data suggest that long-term use of the push-pull system dramatically increases total soil carbon, phosphorous, nitrogen stocks, and beneficial microorganisms, which build soil fertility and improve soil health. The improvements in soil health might explain the basis for the increased drought tolerance observed in the push-pull system. Furthermore, the use of biological N fixation to support crop production in place of synthetic N fertilizer could contribute to reduced fossil fuel dependency and GHG emissions. In this PhD study, systematic work will be undertaken on carbon sequestration, phosphorous availability, and nitrogen fixation with the push-pull technology to estimate its impact on soil health and model its potential role in mitigating climate change.	MSc in analytical chemistry would be advantageous. The student should possess skills in an area of soil science that includes biology or chemistry. Demonstrated attention to detail in their previous work is desirable.
9	Coding of tsetse repellents by olfactory receptor repertoire: towards the improvement and development of new novel tsetse repellents	Tsetse flies are the vectors of trypanosomes, which cause sleeping sickness in humans and nagana in domestic animals. Insect repellents can reduce the transmission of insect vector borne diseases such as trypanosomiasis by blocking contact between blood-seeking insects and their hosts. In this regard	MSc in Entomology or Molecular Biology

		icipe has successfully developed spatial novel repellents from unpreferred animals for savannah tsetse flies (http://www.ncbi.nlm.nih.gov/pubmed/25746973). However, the target olfactory sensory neurons (OSNs) through which the repellents perceived are unknown. In order to improve the tsetse repellents and develop new ones, it is important to investigate the mechanism through which the repellents are perceived at the receptor level. Hence the main focus of this project will be to screen the tsetse repellent components over the whole olfactory sensilla of *Glossina morsitans morsitans* and *Glossina fuscipes fuscipes* to find the neurons responsible for the detection of the repellent components, and to dissect the contribution of each blend components to odor valence and specific behavior.	
10	Olfactory preferences of gravid female stable flies (*Stomoxys calcitrans*) in arid and semi-arid areas where camels are dominant livestock	The stable fly (*Stomoxys calcitrans*) is an important cosmopolitan blood-feeding vector of animal diseases, including surra (trypanosomiasis) in camels. Stable flies have received little attention in comparison with other vectors of trypanosomiasis such as tsetse flies. Egg-laying insects, ensure the survival of their offspring by depositing their eggs in favorable environments. To identify suitable oviposition sites, insects assess a complex range of features including olfactory cues. We hypothesize that olfaction plays an important role in stable fly oviposition site and substrate selection. However, the precise substrates and the chemical cues that trigger oviposition in stable flies remain unclear, especially in areas where camels are dominant livestock. Thus, knowledge on the chemosensory mechanisms of the interaction of the stable fly with the habitat for oviposition could lead to identifying novel attractant(s) that specifically target gravid females. The main focus of this PhD project is to investigate the olfactory preferences of stable flies using chemical, electrophysiological and behavioral techniques.	MSc in Entomology
11	Development of surveillance tools for adult males of selected Afrotropical disease vectors	In the face of rising mosquito-borne diseases worldwide, there is renewed interest in the application of the sterile insect technique to control populations of major mosquito disease vectors. However, operational application of this strategy requires surveillance tools to monitor population density, survival and dispersal of released males, which so far are lacking. By exploiting knowledge of the exclusive plant feeding in males mainly dictated by volatile organic compounds (VOCs), this project has as goal to develop potent lures which can	MSc in Medical Entomology/Organic Chemistry with experience in molecular biology.

		be deployed in existing traps to maximize their captures. Specifically focusing on males of Afrotropical *Anopheles* spp. and *Aedes aegypti*, the PhD project seeks to identify the plant sources for sugars, isolate and identify odors they detect, develop lures to maximize their attraction in conjunction with knowledge of their resting patterns. Standard molecular and chemical ecology techniques will be employed together with behavioral assays in laboratory, mesocosm and field settings.	
12	Development of a semiochemical-based in-hive trapping system for management of Varroa mites in African honeybees	The sudden decline in honey bee colonies is of global concern. One of the major drivers of these losses is the ectoparasitic mite, *Varroa destructor*. Recently these mites were discovered in East Africa and if left untreated could undermine African honey bees health and productivity. Effective control of the parasite has become more difficult since the appearance and spread of mite populations that are resistant to widely used acaricides. In addition, the use of acracidides poses potential risks to honey bee health. This creates an urgent need for alternative control methods for these mites. The use of semiochemical-based pest management techniques, including mass trapping, lure and kill techniques, provide environmentally friendly approaches to major pests. So far, there are neither effective attractants nor repellents known that can effectively be used to lure and consequently kill these mites. The proposed PhD project seeks to exploit key host-finding chemical cues that mediate host cell invasion to trap and kill phoretic mites or to disrupt their cell invasion behaviors through the development of an effective in-hive trapping system.	MSc in Entomology or Chemical Ecology or other related areas. BSc in Agricultural/Biological Sciences. Experience in gas chromatography, insect bioassays and volatile entrainment techniques will be an added advantage.