ASPPWS2018

"Detection, Epidemiology and Management of the Invasive Pests that Threaten Strategic Agricultural Crops in the Arab and Near East Region"

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NEW APPROACHES TO MANAGE THE INVASIVE PESTS

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Smart technologies and biorational technologies have been applied successfully to address challenges present by key invasive pests such as fall army worm and red palm weevil. The access to advanced mobile technology and free access to more radio frequencies have opened opportunities to collect more climatic and biometric data using low power remote sensors as well as farmer's collected data through mobile phone application. The rich and geo positioned big data provides a good opportunity to apply artificial inelegance (A.I.) and to extract accurate trends and forecasts otherwise currently not available. Such data will also provide a golden opportunity to universities to study the behaviour, impact and management strategies of invasive pests across the region. A platform for the management of Red Palm Weevil has been developed. It collects its data via farmer's input of agronomical processes, pest observations and management. It also collects and analyse sound recording data from palm trees undergoing treatment to ensure the success of such treatment. By using image recognition and machine learning techniques, the system can analyse pictures taken by farmers to the pheromone traps in the field. Consequently, we can distinguish, count and report the insect's number directly to the platform providing accurate, geo-positioned and reliable report of the insect activities in the field. The development of a similar system for Fall Army Worm (FAW) is well underway to model the activities and evaluate the efficiency of management strategies of this serious invasive pest. Biorational management strategies have shown a superior performance in managing FAW in Africa. Field trials in Tanzania, Zambia, Zimbabwe and Cameron have shown clearly that RIPM biorational program have given sustainable and successful management tool to the farmers in Africa. The data will show that managing this serious invasive pest successfully can only be done through a holistic approach by stimulating the plant defence system, tackling the pest in the soil as well as on the foliage. The RIPM biorational program is effective against a wide range of lepidopteran pests affecting corn. This makes the program, sustainable and affordable to the wide farmers communities with or without government subsidies. The development of Biorational management system for Date palm crop including RPW is well underway.

1-2

CLIMATE CHANGE IMPACTS ON THE PLANT INSECTS AND PATHOGENS IN THE ARAB REGION

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The climate change has become the major demolition on all the agricultural developmental efforts in the Arab region at the individual, institutional and/or national levels. Climate change has become a reality that imposes itself on the pattern of agriculture in our region. The past and present years have shown a number of phenomena that have negatively affected the cycles of growth and production of many crops. Perhaps, the phenomenon of overlapping seasons and sudden changes in the weather such as wind, Quantities and differences in temperature between the coldness of the cold winter and severe heat in summer, and violence climatic phenomena and their conditions. Agricultural treatments under this changing and hostile climate of the plant kingdom (and animals also) must be changed, and new programs, methods and timing of the agricultural operations should be developed to fit the new and changing situation. In addition, the excessive use of pesticides could be attributed to the increasing reproduction rates of insects from the natural rate dozens of times, which is a chemical stress added to the heat stress. Thus, tolerance traits of all the plant cultivars (vegetables, field crops or fruit trees) are breaking-down. Increased rainfall and humidity have increased the spreading of many fungal and bacterial diseases such as late blight of potatoes and purple blotch of onions and garlics, spots and downy mildew of vegetables, aromatic and medicinal plants and some fruit trees in several regions of Egypt, Syria, Palestine, Iraq, Algeria, Tunisia and Morocco. The increased fluctuation rates of temperature between day and night and between days also led to the spread of many insect pests.

1-3

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2-1

EMERGING PHYTOPLASMA DISEASES AFFECTING FRUIT CROPS IN THE ARAB REGION

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Stone fruit production in Lebanon is threatened by the alarming spread of almond witches' broom (AlmWB), which is a very dangerous disease usually associated with the presence of the phytoplasma, *Candidatus Phytoplasma phoenicium*, in almond trees. This disease is responsible for the death of more than 100,000 almond trees in the country, and is spreading recently to all the cultivated regions, affecting also peaches and nectarines. The disease is representing a threat for the stone fruit production not only in Lebanon, but also in the Mediterranean region. Furthermore, surveys carried-out in the Lebanese fruit tree orchards showed the occurrence of pear decline disease which caused by *Candidatus Phytoplasma pyri* on the pear cultivars; California and Coscia. As well, several disease symptoms were detected on apricots and peaches in Al Giza Governorate, Egypt including; leaf curling, yellowing and fruit malformation. These symptoms which caused a serious yield losses of these trees were found to be usually associated with the presence of the European stone fruit yellows (ESFY) phytoplasma. As well, symptoms resembled those caused by phytoplasmas were observed in Al-Jubiha and Homret Al-Sahen area, Jordan where aster yellows phytoplasma (16SrI) were found to be affecting peach trees, there. *Candidatus* Phytoplasma prunorum was detected in Tunisia on apricot trees that showed early leaf reddening in autumn, and off-season growth in winter followed by dieback. Surveys carried out in the Lebanese vineyards located in Bekaa and northern Lebanon showed typical grapevine yellows (GY) symptoms including leaf discoloration and curling, berry shriveling and irregular maturation of wood on the vines cv. "Chardonnay". Molecular diagnosis indicated the presence of *Ca.* Phytoplasma solani associated with bois noir (BN). Recently, during a field survey in June 2014 for BN in West Bekaa, Lebanon, *Ca*. Phytoplasma omanense was detected in a grapevine sample, cultivar Syrah, exhibiting leaf scorch and discoloration. In 2010, symptoms of (GY) diseases have been observed in some coastal grapevine growing areas in Syria where two phytoplasmas were identified in mixed infection; one related to stolbur (16SrXII), and the other tentatively related to clover proliferation group (16SrVI). Apart from Lebanon, in 2012, grapevine yellows (GY) affecting Jordanian vineyards was reported to be associated with *Ca*. Phytoplasma solani, the bois noir (BN) etiological agent. In Tunisia, phytoplasmas in the aster yellows group infecting grapevine exhibiting symptoms of grapevine yellows were identified. On citrus, Witches' broom disease of lime (WBDL) caused by *Candidatus Phytoplasma aurantifolia* was first observed in the Sultanate of Oman where thousands of lime trees were killed since the 1980s and found to be present in the United Arab Emirates (UAE) in 1989. On date palm which is one of the most important cash crops in Saudi Arabia, a date palm phytoplasma disease (Wijam) is an emerging economical threat to the production of dates resulting in a loss of more than 30-40% of date production and the death of thousands of palm trees. In Egypt, phytoplasma-like symptoms were also detected in date palm trees causing leaf chlorotic streaks, stunting and marked reduction in fruit. Conventional strategies for phytoplasma containment in the Arab region can be controlled by developing a coherent and modern legislative framework in the field of production of certified propagation materials, improving phyto-sanitary inspection of imports to meet quarantine regulations, improving nurseries certification system (formal or informal), and strengthening human capacity in pathogens diagnosis and controlling phytoplasma insect vectors.

2-2

NEW INSECT-BORNE VIRUS DISEASES AFFECTING CHICKPEAS IN THE ARAB REGION AND POTENTIAL APPROACHES TO MANAGE THEM

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Viruses causing yellowing/stunting are the most important viral diseases affecting chickpea in many regions of the world including Arab countries. These diseases were thought for many years to be mainly caused by the infection with *Beet western yellows virus* (BWYV) which belong to the genus *Polerovirus*, family Luteoviridae. Recently, it has clearly shown that there are a number of *Polerovirus* species (e.g. *Chickpea chlorotic stunt virus, Cucurbit aphid-borne yellows virus,* and *Beet western yellows virus*), can cause yellowing/stunting symptoms in chickpea in West Asia and North Africa countries. Lately, virus epidemics were reported from these countries, sometimes causing considerable yield reduction. It was found that epidemic spread of these diseases was always associated with high aphid vector populations and activity. Although virus disease management can be achieved through the combined effects of several approaches, development of resistant genotypes is, undoubtedly, one of the most promising control components. Experience gathered over the last few decades clearly showed that no single method of virus disease control suffices to reduce yield losses in chickpea crops. Some progress was made in the disease management of some chickpea viruses using a combination of healthy seed, host resistance, cultural practices (e.i. adjustment of planting date, plant density, rouging of infected plants early in the season) and chemical vector control.

3-1

ROOT ROT FUNGAL PATHOGENS AFFECTING CEREAL CROPS IN THE ARAB AND NEAR EAST REGION AND POTENTIAL APPROACHES TO MANAGE THEM

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Root and crown diseases are complex and their control strategy is challenging, compared to other foliar diseases such as rust and leave necrosis. Disease caused by soil-borne pathogens including the take-all disease caused by *Gaeumanomyces graminis var. tritici*, crown rot caused by *Fusarium pseudograminearum* and *F. culmorum*, the common root rot caused by *Bipolaris sorokiniana*, Barepatch caused by *Rhizoctonia solani*, attack the roots of cereal crops causing high yield losses and reduce the grain quality and quantity. The damage caused by these diseases is accelerated in the areas, where water stress and monoculture practices are dominating. Sustainable agricultural production of rain fed crop exposed to drought, especially those growing under arid and semi-arid conditions, is being affected by climate change that leads to hotter and drier soils. It is important to recognize that a plant's ability to save adequate amounts of water is affected by the destabilizing effects of root rotting fungi on root architecture. Integrated crop health management approaches, including resistant and/or tolerant cultivars, technologies that simulate root health and growth coupled with modern nematode/fungi management strategies such as chemical, biological and cultural methods are needed for sustainable production in the ever-drier environments that are now a reality in many areas of the world. Resistance is environmentally safe and effective control method. However, most of the cultivars that widely grown in the Arab and near east region lack resistance to root-rot diseases. Therefore, alternative approaches to eliminate the damage caused by soil-borne pathogens are needed. Extensive screening of wheat germplasm against soil-borne pathogens has identified many of the moderately resistant winter and spring wheat germplasm against nematodes and crown rot fungi. Actually, crown rot fungi remain a significant bottleneck in many wheat-growing areas all over the world. Hundreds of wheat germplasm are screened annually against soil-borne pathogens at the International Maize and Wheat Improvement Center (CIMMYT), Turkey in collaboration with the Grains Research Development Corporation (GRDC). As a result, many new moderately resistant and resistant germplasms have been identified. These sources of resistance had not previously reported and their quantitative trait loci (QTL's) have been identified. The new sources of resistance against the soil-borne pathogens could be useful for selecting parents and deploying resistance into elite germplasm adapted to the region. Nematologists, breeders and agronomists need to work together to find solutions to the complex issues facing agricultural production, and to use multidisciplinary approaches to move forward in insuring food security for all. Recent research within the soil-borne pathogens programs at CIMMYT has focused on germplasm screening, the potential of this germplasm as a source of resistance and how to incorporate the new sources of resistance into breeding programs. Breeding for resistance is particularly complicated and difficult when different species and pathotypes coexist in nature. To accelerate breeding for resistance to soil-borne pathogens; expertise and recognition of these pathogens are needed. Appropriate breeding strategies, faster screening processes, and sufficient research funding are required for more holistic approach to plant health management.

3-2

HETERODERA AVENAE INFECTING WHEAT IN THE ARAB WORLD: INCREASING SPREAD, BIOLOGY, DAMAGE POTENTIAL AND MANAGEMENT

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The cereal cyst nematode (CCN), *Heterodera avenae* Woll., has a global distribution and causes significant yield losses to wheat and some other cereal crops in many countries worldwide. In the last few decades, *H. avenae* has been reported from some Arab countries including Egypt, Lybia, Saudi Arabia, Morocco, Palestine, Syria, Algeria and Tunisia. The nematode has becoming a major threat to the wheat production in these countries. In some trials, the nematode caused wheat grain losses reached up to 92 and 96% in the heavily infested field plots in Saudi Arabia and Tunisia, respectively. The species of *H. avenae* has a number of pathotypes that could be differentiated with a differential host assortment including certain cultivars of wheat, barley and oats. Disease symptoms by *H. avenae* in wheat fields are usually shown as patches of pale and stunted plants. Symptoms on the aerial parts of infected plants greatly resembling the symptoms of severe nitrogen and other mineral deficiencies. Infected plants also show no or a very limited tillering, wilt readily in the dry weather and their roots show more proliferation with a light swelling of their tips. The nematode life cycle includes one generation a year with a duration period of approximately 75 days. Management program of *H. avenae* in wheat fields should include both short- and long-term strategies. The short-term strategy is mostly depending on the application of an effective nematicide. While, the long-term strategy should include; sanitation, resistant and/or tolerant cultivars, crop rotation with a non-host crop accepted by the farmers, cultural practices and the application of herbicides to control weed hosts, if present.

3-3

BACTERIAL WILT OF POTATO: DETECTION OF THE PATHOGEN AND DISEASE CONTROL

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Potato is one of the most important plant crops worldwide and in Egypt as well. Unlike, many fungal, bacterial and viral diseases are attacking potato and severely affecting the quantity and quality of its yield. Among these disease, potato bacterial wilt (also known as potato brown rot disease), caused by *Ralstonia solanacearum* is the most serious one. This disease is also considered as a quarantine disease. Many identification techniques are efficiently used for detection and identification of *R. solanacearum i.e.* planting on semi selective modified South Africa medium (SMSA), immunofluorescent antibody staining (IFAS), polyclonal antibodies, tomato bioassay, conventional polymerase chain reaction (PCR) and real time PCR….etc. Yet, no chemical control methods were found to be successful for controlling the potato bacterial wilt. Therefore, the disease incidence can be only decreased if more than one control components could be combined. These control components include: planting healthy seeds in sterilized soil, planting the resistant or tolerant potato cultivars, crop rotation including non-hosts, sanitation and using the antagonistic bacteria as a biological control.

4-1

PREVENTION AND CONTROL STRATEGIES OF KHAPRA BEETLE, *TROGODERMA GRANARIUM* EVERTS (COLEOPTERA: DERMESTIDAE), A POTENTIAL INVASIVE STORED PRODUCT INSECT PEST

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The khapra beetle, *Trogoderma granarium* Everts (Coleoptera: Dermestidae) is one of the most important quarantine insect pests attacking the stored products worldwide. Within the Euro-Mediterranean *region*, there are some areas, where *T. granarium* is endemic, including the southern Mediterranean, from Morocco to Egypt. It is also a threat of stored product insect in; Turkey, Middle East, India and Pakistan. Although, *T. granarium* was detected in some *European Union* countries such as; Italy, the Netherlands, Austria, Luxembourg, Belgium, Spain and Hungary, there is no evidence of its establishment in any of these countries. The larvae of *T. granarium* feed on a wide variety of the dry stored products, including cereals, and dry animal products. The great economic importance of this insect is due to its capability to cause huge losses in the stored grains through voracious feeding and heating of grains, the larval ability to tolerate starvation for up to 3 years, as well as in its ability to live on food with very low moisture content. Also, the larvae can undergo dormancy in response to adverse conditions. Therefore, it has been recognized as an A2 quarantine organism for European and Mediterranean Plant Protection Organization (*EPPO*) and ranked as one of the 100 worst invasive species worldwide. *T. granarium* is of quarantine concern because its spread is mainly through international trade. Effective control methods of this insect are crucial to ensure the food safety situation. Similarly, controlling this insect is essential requisite for export of the wheat and other cereal grains. Although, traditional treatments of stored grains for managing other species of stored grain pests may control khapra beetle and sufficiently prevent economic losses caused by this insect, the development of resistance and the lack of effective fumigants are new challenges for *T. granarium* control. Economic losses caused by this insect, distribution, quarantine importance and integrated pest management (IPM) of *T. granarium* will be discussed.

4-2

LOOP MEDIATED ISOTHERMAL AMPLIFICATION (LAMP) ASSAY FOR RAPID IDENTIFICATION OF PLANT PATHOGENS

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Loop mediated isothermal amplification (LAMP) is an emerging nucleic acid amplification method that allows DNA amplifies with high specificity, efficiency and rapidity under isothermal conditions. LAMP has a substantial advantages over PCR-based methods for the identification of some plant pathogens, where it can be implemented in a single step process at a constant temperature (65ºC). The main appeal of this technology is its simplicity regrading to remove the need for thermal cycling allows for on-site diagnostics, and does not require expensive instruments and sophisticated method of detection. This method employs a DNA polymerase (uses typically *Bst* polymerase) with high strand displacement activity that making it less susceptible for inhibitions and a set of four to six different primers designed specifically to recognize six to eight distinct regions on the target DNA. The LAMP method is highly tolerant and sensitive, as it is not considerably influenced by the existence of non-targeted biological contamination. Since its development by Notomi in the year 2000, LAMP has undergone numerous advancement in terms of its applications as a molecular amplification technique, including conventional LAMP, reverse-transcription LAMP, multiplex LAMP and a few other LAMP forms for detection of micro-organisms. LAMP has been used to detect several plant pathogens (bacteria, phytoplasmas, fungi, viruses, viroids and nematodes) as well as some insect pests.

4-3

PLANT PROTECTION CHALLENGES IN THE ARAB REGION: PROSPECTS OF 2050

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The idea of developing a task force to develop a report on "Plant protection challenges in the Arab region: prospects of 2050" was initiated during the 12th Arab Congress of Plant Protection, held in Hurghada , Egypt during the period 5-9 November, 2017 when FAO representative announced that the UN is considering declaring the year 2020 as the "Plant Health Year". Accordingly, the Executive Committee of the Arab Society of Plant Protection (ASPP) decided on this occasion to establish a task force of selected members to write the proposed report and have it ready for wide discussion at the 13th Arab Congress of Plant Protection which will be held in Tunisia in 2020. The ASPP Executive Committee found in the UN declaration an opportunity for the plant protection scientific community in the Arab world to get engaged in assessing the plant protection situation in the region and establishing a vision on the challenges in plant protection and its role in food security that the region will be facing in the coming few decades. It is also an opportunity for a scientific society, such as ASPP, to demonstrate that it has a role to play towards the welfare of the Arab communities. In advanced countries, scientific societies has an important role to play in developing strategies and programs to be implemented by governments. That is why ASPP found itself obliged to play such role, and this is the first report launched by ASPP in serving the Arab region. Since we are at present at the early stages of developing such report, I will present to the participants of this workshop the steps implemented so far, such as the team development, establishing a tentative table of contents, with assignments to each team member, and a time table on how to finish it. I will also present the main challenges that will be covered by the report for the purpose of discussion and also to motivate some of the audience to join the task force members in completing this important task in the best possible way.

5-1

CURRENT STATUS OF THE RED PALM WEEVIL IN EGYPT, AND ITS TRADITIONAL AND NEW CONTROL MEASURES

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The red palm weevil (RPW) *Rhynchophorus ferrugineus* (Olivier) (Coleoptera: Curculionidae) is the most important pest of palms worldwide. The first record of this pest in Egypt was registered at date palm plantations in Sharkia and Ismailia governorates. Unlikely, the pest has currently distributed in 26 Egyptian governorates and the percentage of palm infestation in these governorates is ranging between 2 - 35%. The date palm is considered as the most economically important agricultural crop in Bahria and Siwa oases and Aswan, with an infestation percentage exceeded 20%. The highest infestation level with this pest was recorded in 2014, where more than 250,000 date palm trees were found infested with RPW. The total estimated control costs of this pest in Egypt reached up to 354 million L.E. (about 20 million USD) a year. These costs included; labor costs for periodic investigation (2700 person to investigate 6000 palm tree/person/month = 4.55 million USD per year), protective spraying (13.4 million USD), and quarantine operation, removal of highly infested palms, injection and extension which cost about 2-3 million USD. Such costs are very difficult to be covered. Consequently, the damage of palms is increasing. Government's role in helping farmers to fight against the pest is confined only in the work of guidance seminars about the threat of the pest and its life cycle, the control measures and providing the necessary pesticides at low prices. The traditional control measures mostly used were; pesticides spraying and injection, palm removal, prevention of transferring the infested offshoots, agricultural extension and use of pheromone traps in some areas. However, the application ways are weak, so the percentage of infestation has increased. Besides, there are some disadvantages of some traditional methods such as injection by pumps, which cause problems for palm trees. This method is very costly and requires large quantities of pesticides and labors as well. The modern control measures, however, include the using of; devices for early detection, mobile applications, aggregation pheromone traps in all areas, as well as developing the quarantine detection means and protocols and developing detection techniques of RPW. These measures would surely reduce the RPW controlling costs and increase its controlling efficiency.

5-2

NEW APPROACHES FOR FRUIT FLIES CONTROL

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Fruit flies occupy the most importance in controlling programs either in Egypt, Arab countries or in the whole world. This importance is due to the damages that caused by the larval feeding inside the infested fruits leading to a great yield losses and, thus, negatively affecting the local and exporting markets. Efforts usually made to develop new methods for controlling these serious pests. The modern control methods are usually depending on:

- Analyzing the Pest Risk and suggesting several control actions to finally, select the best one.
- Training the technical staff on selected plans.
- Starting the Geographical Information System (GIS), where the action plan should be linked to the fluctuation numbers of flies in different hosts and to the forecast (temperature, humidity, rains, winds) and geographical position.
- Mapping the host and insect distribution, in addition to the distribution of technical staff and control tools in each site.
- Conversion of the obtained data to be used in the determination of hotspots and prediction the spreading of flies (direction and speed).
- Propagandas in different media to improve civilians' awareness with the dangerous effects of flies on the economical level.
- Following-up the action plan to detect any defect could be popped up.
- Including the IPM tools such as: Legislation, Agricultural, Mechanical, Physical, Chemical, Biological and Autocidal Control.
- Using of postharvest treatments to protect the fruits from any new infestations.
- Increasing the mass trapping method to collect the emerged flies and avoid infestation.
- Increasing the awareness to use the new methods of baits application technique (BAT).
- Data Exchange of infestation rates, general fluctuation of flies with the neighboring areas in order to take action whenever needed.
- Strengthen the passenger awareness about avoiding picking up fruits between countries, unless it accompanied by a certificate confirming the free from infestation.
- After the control get done, a special team should be formed and standby to apply any control methods for a sudden infestation cases.
- Recommendations should be taken place to initiate a regional project among the neighboring countries to eliminate fruit flies and prevent its spread.

5-3

FALL ARMYWORM *SPODOPTERA FRUGIPERDA* SMITH (LEPIDOPTERA, NOCTUIDAE): THE THREAT FROM SOUTHERN AFRICA TO ARABIC REGION

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The Fall Armyworm (FAW), *Spodoptera frugiperda* Smith (Lepidoptera: Noctuidae) has originally occurred in the tropical and subtropical regions of the Americas. Its larvae cause significant damages to the infested crops. In the absence of the management programs, the insect might have several generations a year. The insect also have a wide host range including more than 80 plants, but clearly prefer grasses. The most frequently injured field crops are: alfalfa, barley, wheat, cotton, clover, corn, oats, millet, peanuts, rice, sorghum, sugar beets, soybeans, sugarcane and tobacco. The other vegetable crops which might be attacked with this insect include: tomatoes and pepper. There are also some weeds that might serve as hosts. FAW is very difficult to be controlled in the corn fields. Late sown plants and late maturing hybrids are more likely to become infested. Fall armyworm causes serious leaf damage as well as direct injury to the ear. Generally, the fall armyworms can damage corn plants in nearly all of their developmental stages, but the damage is likely to be more severe on the later plantings. Like the European corn borer, fall armyworm can be controlled effectively only, when the larvae are younger. Early detection and the suitable timing of an insecticide application are critical for control. FAW was first reported in central and western Africa in the early 2016, and has then quickly spread across virtually all of sub-Saharan Africa, because of trade and the moth's strong flying ability. The moth can fly up to 100 km per night and the female moth can lay up to 2000 eggs during its lifetime. Farmers will need great support through integrated pest management to sustainably manage FAW in their cropping systems. In the Americas, farmers have managed FAW in their fields for many centuries, and researchers have studied it for decades. Sustainable management practices that are used in the Americas could be adapted to Africa's socio-economic-environmental context.

6-1

FIRST RECORD OF THE COCHINEAL SCALE INSECT, *DACTYLOPIUS OPUNTIAE* (COCKERELL) (HEMIPTERA: DACTYLOPIIDAE) IN JORDAN

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The cochineal scale insect, *Dactylopius opuntiae* (Cockerell, 1896) (Hemiptera: Dactylopiidae), was reported for the first time in Jordan herein. The scale insect was collected from several localities in the north of the country, where it was found attacking the Indian-fig prickly pear, *Opuntia ficus-indica* (L.) Miller (Cactaceae). Plants that were exposed to heavy infestations by the pest were being killed. A map was prepared to illustrate the geographical distribution and the relative degrees of infestation by this insect in Jordan. Voucher specimens of the collected insects were preserved in the University of Jordan Insect Museum. Adult females were mounted on glass slides, and photographed with a digital camera to show their important diagnostic characters. In addition, world distribution, morphology, control methods, natural enemies and the possible ways of the entry of this serious pest to Jordan were discussed.