Adoption of biointensive IPM to enhance the development of organic date palm cultivation in the Arab countries

Mohamed El-Said El-Zemaity

Dept. of Plant Protection, Fac., of Agric. Ain Shams University

E- mail: mselzemaity@hotmail.com

ABSTRACT

Recently, there has been an increased demand on organic date in the developed as well as developing countries including the Arab countries. However, there are certain challenges for developing organic date palm cultivation in the Arab countries which are the main global producers of dates. Since the pest management practices should be applied in accordance with the valid standards of organic date production, the insufficient management of pests is one of the major reasons of such constraints. In fact, knowledge of organic-agriculture standards and available required information of the all components of IPM strategy is very important to develop adequate programs to manage the pest problems in organic farming; available data indicate that the basic components include: biological and ecological aspects of the target pest, field monitoring and scouting, threshold /action levels and natural controls, whereas, the methods and tactics which are commonly used as main and potential components to implement the IPM program include: regulation and legislative interventions, agricultural methods, attractants and pheromone traps and biological control. When the organic management practices alone cannot prevent or control pests, a biological or botanical substance may be applied through biointensive integrated pest management (Bio-IPM) programs. Consequently, bio-IPM is not just about management of pests alone, it is a sustainable crop production system based on sound eco-system analysis. However, there are certain constraints on its wide-range implementation in the Arab region. This paper highlights the current situation of IPM levels in Arab region and the need to overcome constraints and encourage the implementation of

Table.1. Possible natural enemies of the main date palm pests

English/ Scientific name	Possible Natural Enemis	Source
White scale/ Parlatoria blanchardii Targ	Hemisarcoptes malus, Chrysoperla vulgaris, Cardiastethus nazarenus, Coccinellidae (29 species), Nitidulidae (5 species), Mycetaeidae (1 species), Aphytis mytilaspidis, Cybocephalus nigriceps, Cybocephalus rufi frones, Chilocorus bipustulatus var. .iraniensis and Chilocorus sp	.FAO, 1995
Red scale/ Phoenicococcus marlatti. ,cockerell	General predators, such as Pharoscymnus anchora-.go (Fairmaire), are considered as active predators	Zaid et al., 2002
Red palm weevil (RPW)/ Rhynchophorus ferrugin-.eus Oliv	Entomopathogenic nematodes (Heterorgabditis species or Steinernema sp.) - Entomopathogenic fungi (Beauveria bassiana, Metarhizium anisopliae) - Entomopathogenic bacterium (Bacillus thuringi-(ensis	Dembilio and Jacas, .2013
The dubas bug/ Ommatissus binotatus var. Lybicus (De (Bergevin	The egg parasitoid Pseudoligosita babylonica (Hy-.(menoptera: Trichogrammatidae	Hassan et al., 2003; Hubaishan& Bagwaigo, .2010

bio-IPM programs in organic date palm farms.

Key words: Organic date, Pests, Adoption and implementation, Biointensive IPM

INTRODUCTION

Organic agriculture includes all agricultural practices that promote the environmentally, socially and economically sound production of food. Crop production and pest control methods in organic agriculture are governed by strict standards and rules imposed by the International Federation of Organic Agriculture Movement (IFOAM) and national regulations. These standards applies to the unprocessed and processed products that carry or are intended to carry descriptive labelling referencing organic production methods. On the other hand, organic production is generally associated with different challenges; the major challenges include low quality palm cultivars, poor farm management, pest and disease control (and inadequate IPM: integrated pest management), harvesting, processing and marketing, shortages of national qualified and trained staff and labour, and insufficient research and development (Mahmoudi, et al., 2008). Regarding organic date palm cultivation, dates shall refer to organic production only if they come from a farm system employing management practices that seek to nurture ecosystems in order to achieve sustainable productivity; and that provide weed, pest and disease control through a diverse mix of mutually dependent life forms, recycling of plant and animal residues, crop selection and rotation, water management, tillage and cultivation (United Nations, 2003; Azadi et al., 2006; El-Zemaity, 2007b; Safwat, 2007).

Some Arab producers have diversified into organic production of dates. For example, Tunisia export certified organic dates to the European countries, the main market is Germany. Tunisia exported 678 tones of organic dates (The official production Figure was 107 000 tones for all varieties) in 2000-2001, up 60 percent from 425 tones in the previous season (Fruitrop, 2001). The recent data indicated that in 2011, 6,000 tons of organic dates were harvested in Tunisia, of which 4,000 tons (67%) was exported; 68% of this went to Germany, 11% to the United States and 7% to Morocco (Source: Freshplaza.com). Although Tunisia accounts for only 2 percent of world date production, its share of global exports in value is 21

Table.2. Permitted and restricted pest management tools in organic farming.

Permitted	Restricted
- Carbon dioxide, nitrogen, freezing, heating and vacuum treatment.	(Substances used only in case of immediate threat to organic foods becoming unfit for consumption due to infestation)
- Mechanical, sound or light barriers.	- Pyrethrum derived only from a natural source.
- Electric flying insect control units.	- Synthetic pyrethroids for the treatment of sealed units
- Tamper resistant bait stations.	
- Pheromone traps & sticky boards.	
- Diatomaceous earth & amorphous silica.	
- Particle film barriers (processed kaolin clay).	
- Sugar esters	
Compost teas.- s.	
- Botanical products.	
- Microbial products.	
- Organically approved chemicals (Bordeaux mixture, sulfur and copper)	

percent. It represents 55 percent of EU imports in value. Tunisia exports about the same quantity of processed and natural dates. Algeria came the second with a market share of 20 percent of EU imports in value. The official production Figure in 2000 was 365 000 tones for all varieties. Algeria exports more natural dates than processed dates, as there is a lack of processing capacity. The quasi-totality of Algerian dates is destined for France (Fruitrop, 2001). Among organic fruits, date palms are of major importance in other Arab counties such as Egypt, UAE, Palestine and Saudi Arabia. Organic date production of these countries is locally distributed (Hartmann, et al., 2012).

As conventional date palm the organic date palm cultivation and its fruits could be subject to attacks by several pests that are, in most cases, well adapted to the oasis environment. The main causes of date palm damage include insect pests, rodents and diseases (Naturland, 2002; Blumberg, 2008; Mahmoudi, et al., 2008). The damage caused by such pests is considerable and leads to heavy economic losses. Most of pest control operations employing pesticides are either restricted or not permitted not only in organic date but also at all in organic products. The principles of pest control in organic farming are based on: (i) prevention of infestation, (ii) avoiding the contamination of organic foods by any form of infestation, (iii) avoiding any contamination of organic foods with plant protection products, and (iv) the use of substances which not adversely affect the environment. Generally, IPM is a set of management activities that farmers implement to maintain the intensity of potential pests at levels below which they become pests, without endangering the productivity and profitability of the farming system as a whole, the health of the farm family and its livestock, and the quality of the adjacent and downstream environments. Consequently, IPM is not just about management of pests alone, it is a sustainable crop production based on sound ecosystem analysis. However there are certain challenges that constrain its wide range implementation (Guan Soon, 1996; Dhaliwal and Heinrichs, 1998).

Considering all mentioned previously, it is highly expected that the Arab countries which are the main producers of dates will face some of constraints in developing of organic date cultivation. So, the present paper highlights the current situation of IPM levels in Arab region and the need to overcome constraints and encourage the implementation of bio-IPM programs in organic date palm farms.

DISCUSSION

Possible causes of date palm damage in organic cultivation

All parts of offshoots and mature date palm tree could be exposed to the infestation by different abiotic as well as biotic disorders includes pests and diseases. The

main pests which include insects; mites; plant pathogens; weeds; rodents and birds are similar in most of the Arab countries (Fig. 1). Some of these pests are considered serious pests in certain countries, whereas considered moderate or minor pests in the others. Among of these pests the two main serious pest-threats in date palm plantations now are the Red Palm Weevil (Rhyncophorus ferrugineus) and the fungal disease Bayoud (Fusarium oxysporium) (Calcat, 1959; Carpenter and Elmer,1978; Al-Azawi, 1986; Howard et al., 2001; Zaid et al., 2002). Other date palm disorders such as environmental, physiological and propagation factors could be causes of considerable damage in each country. The occurrence of date palm pests and/or injury symptoms is depending on the development-stage and the environmental factors. Naturland, 2002 reported that most of the problems concerning disease and pests have different causes, i.e. (a) monoculture cultivation and use of non-resistant and/or of few varieties; (b) insufficient distance between species that grow to the same height, failure to trim agro forestry systems; (c) unfavorable soil conditions like degenerated or poor soil, soil not deep enough for roots, lack of organic material, high salinity etc and (d) unsuitable site conditions (deep water table, insufficient irrigation, drought, temperature, high rainfall level etc.). It is worth mentioning that the absence of adequate management of such disorders could cause considerable damage and lead to heavy economic losses.

Requirements of pest control in organic date palm

Pest control (including insect pests, diseases and weeds) shall be centered on organic management practices aimed at enhancing crop health and minimizing losses caused by such pests. When the organic management practices alone cannot prevent or control possible pests, a biological or botanical substance or other substances may be applied (British Pest Control Association, 2002). However, the conditions for using the substance shall be documented in the organic plan. Pest management plan should be based on essential considerations: (1) appropriate practices should be adopted to prevent pests and avoiding the contamination of organic food by any form of infestation from microorganisms, insects or other pests; (2) control measures should be achieved mainly by means of scrupulous cleaning procedures and hygiene controls adopted within and around warehouse and storage areas, food preparation areas and for all contact surfaces, within particular emphasis given to the frequent and regular cleaning of inaccessible areas; (3) the permitted pest control substances which does not adversely affect the environment may be used if these practices are ineffective and must be used without any risk of contamination; and (4) the use of chemical means of pest control should be kept to minimum, and restricted substances should lead to the organic products losing their organic status. These emphasize that the pest management practices should first involve the removal of pest habitat and food; second, the prevention of access and environmental management (light, temperature and atmosphere) to prevent pest intrusion and reproduction; and third, mechanical and physical methods (traps), permitted lures and repellents. On the other hand the operator shall, however, ensure that any pest control substance used does not come in contact with the organic raw materials or product, and shall record the use and disposition of all such substances. These requirements could be implemented through the bio-IPM strategy which emphasizes on proactive measures to redesign the agricultural ecosystem to the disadvantage of a pest and to the advantage of its parasite and predator complex (UIUC, 1997).

Biointensive integrated pest management (Bio-IPM) system and planning the suitable program

Biointensive integrated pest management (bio-IPM) is a system approach to pest management that is based on an understanding of pest ecology. It begins with steps to accurately diagnose the nature and source of pest problem, and then relies on a range of preventive tactics and biological measures to keep pest populations within acceptable limits (Leslie and Cuperus, 1993; Steiner, 1994; Altieri, 1994). Reduced risk pesticides are used if other tactics have not been adequately effective, as a last resort and with care to minimize risks. Generally, bio-IPM has many of the same components as conventional IPM, including monitoring, use of economic thresholds, record keeping, and planning (El-Zemaity, 2006). On the other hand, bio-IPM system is affected by several factors such as: economic costs and benefits of individual components; emergence of new pests, resistance or unusual weather problems; the skill and competence of field personnel conducting scouting, designing tactics and assessing effectiveness of given strategies; the impact or importance of preventive practices; availability, or lack thereof of effective alternative pest management products; and the complexity of interactions among pests, beneficials, cropping

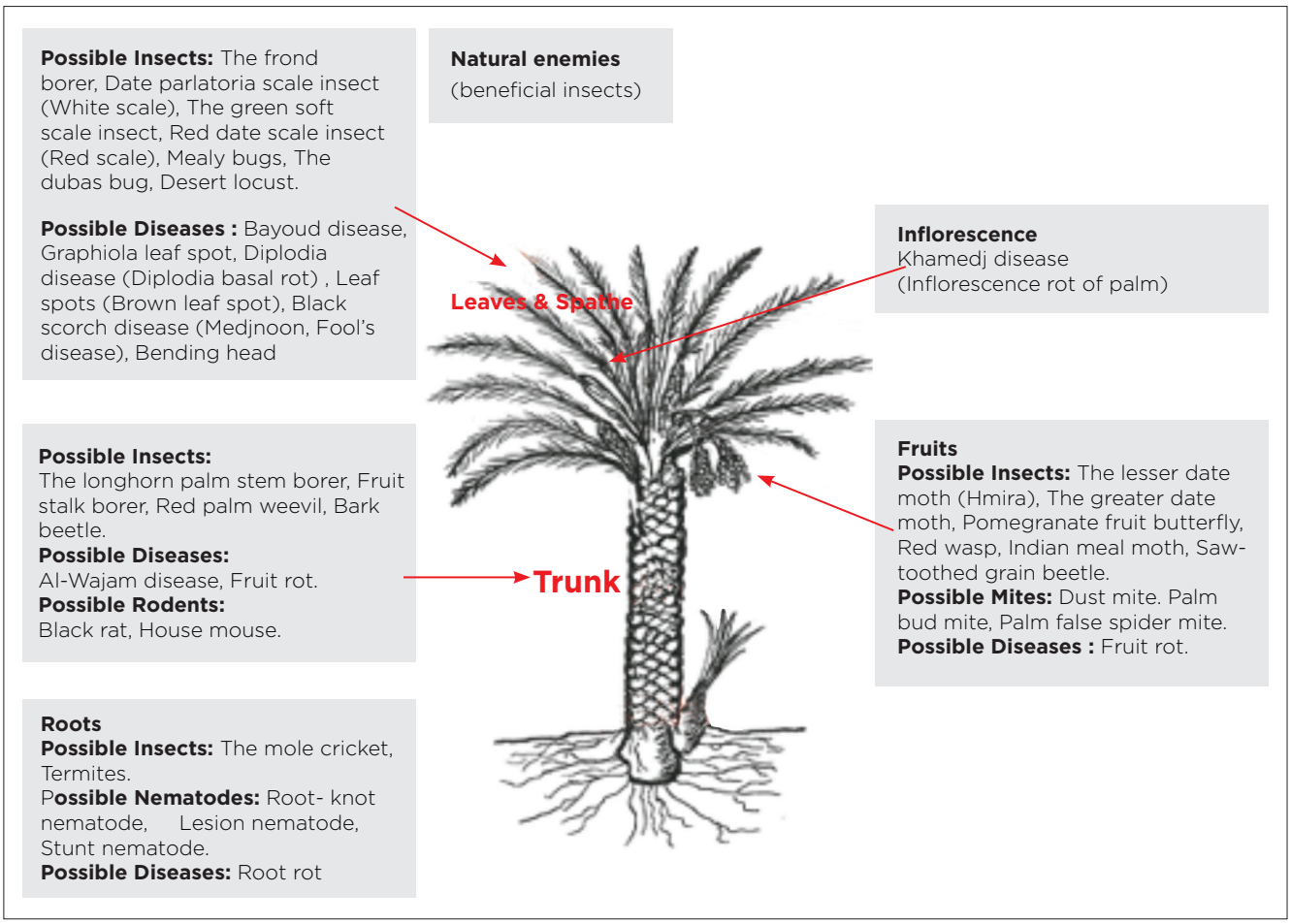

Fig.1A. Agro-ecosystem Analysis Chart for Date Palm

practices and control measures. Moreover, all IPM programs, regardless of the situation, share the components of monitoring the pest population and other relevant factors; accurate identification of the pest; determining injury levels and threshold that trigger treatment; timing treatments to the best advantage; spot-treating for the pest; selecting the least – disruptive tactics; evaluating the effectiveness of treatment to fine – tune future actions and educating all people involved with the pest problem (El-Zemaity, 2007a).

Good planning must precede implementation of any IPM program, but is particularly important in a biointensive program. Planning should be done before fruiting season because many pest strategies require steps or inputs, such as beneficial organism habitat management that must be considered well in advance. Attempting to jump-start an IPM program in the beginning or middle of a season generally does not work.

The current situation of IPM levels in the Arab region

Measuring the success and improving the efficiency of IPM actions by adopting better application practices require accurate evaluation of the current management programs. The success of the IPM program can be measured by the ability to maintain infestation levels below threshold level or a given % in a target area. In fact, information on the degree of adoption and evaluation of IPM practices in the Arab countries is very lacking (El-Zemaity, 2006). Regarding the actual implementation of IPM along the Arab region, it could be classified to 3 categories of adoption (low, medium and high – level IPM), with the exception of chemical control level which no practices of IPM (or no IPM) are employing and the system is essentially dependent routinely

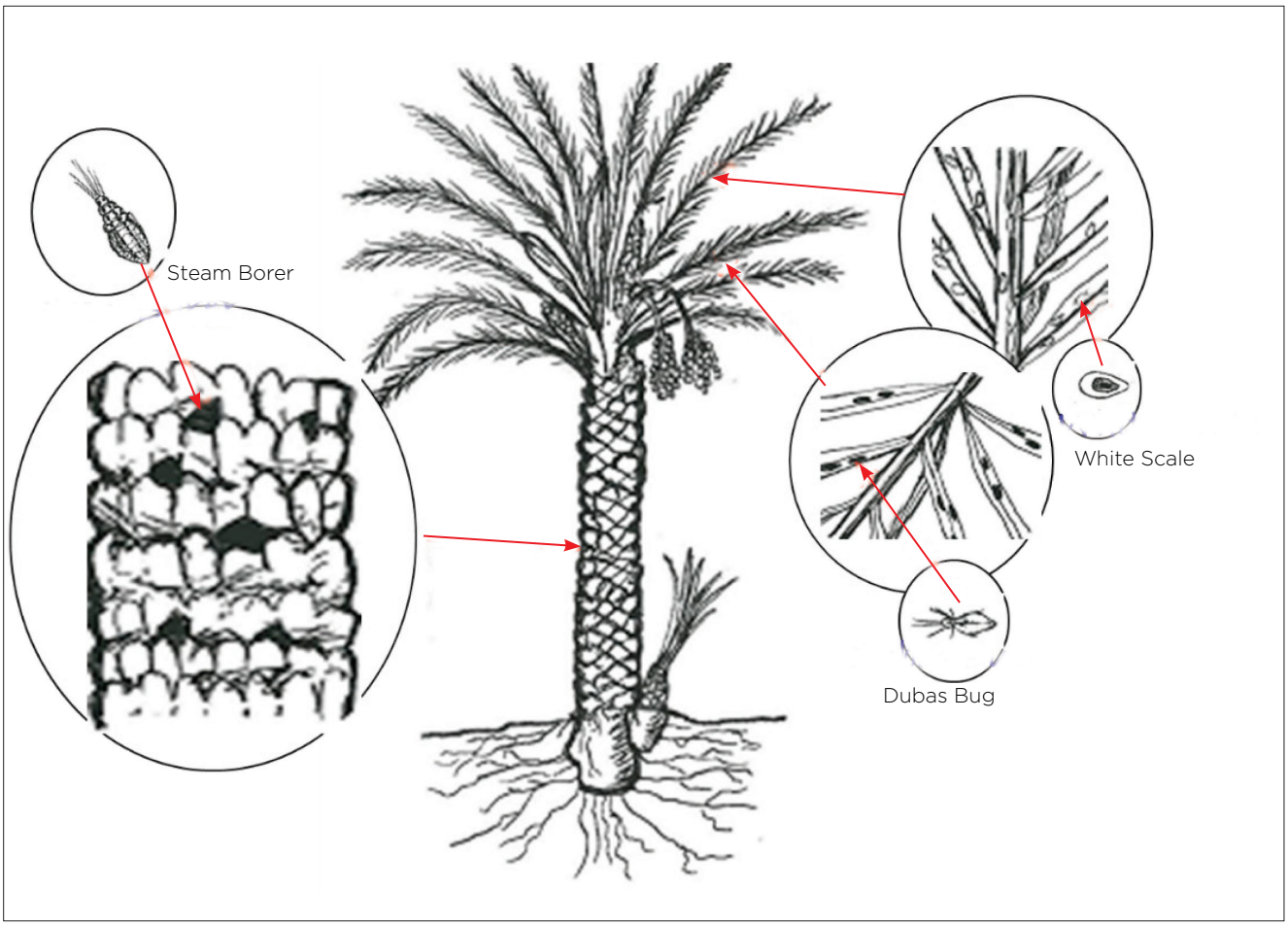

Fig. 1B. Agro-ecosystem Analysis Chart for Date Palm

on insecticides (El-Zemaity, 2013). The adopted practices of the three categories may include: (1) low – level IPM, employing at least the most basic IPM practices-scouting and applications in accordance with economic threshold/ area-wide management; (2) medium – level IPM, some preventive measures, coupled with efforts to cut back on broad spectrum of insecticide use and (3) high – level IPM, integration of multiple preventive practices to control the insect without relying on insecticides such as in organic farming. The high – level IPM is the most advanced IPM and termed as the bio- intensive IPM.

The actual percentages of current IPM adoptions levels in each Arab country are not well known. This may require encouraging researches on the evaluation of the adopted IPM programs under the local condition of each country. Such researches have become necessary to improve our understanding of the success and true impacts that can be expected from the commonly used IPM practices.

Successful implementation of Bio-IPM approach

1. Pest identification (pest diagnosis) - A crucial step in any IPM program is to identify the pest. The effectiveness of both proactive and reactive pest management measures depend on correct identification. Misidentification is actually harmful and costs time and money. Help with positive identification of pests may be obtained from university personnel, private consultants, the cooperative extension service, books and websites. After a pest is identified, appropriate and effective management depends on knowing answers to a number of questions related to the pest life cycle and the role of agricultural practices in enhancement its natural control. So, monitoring (field scouting) and economic

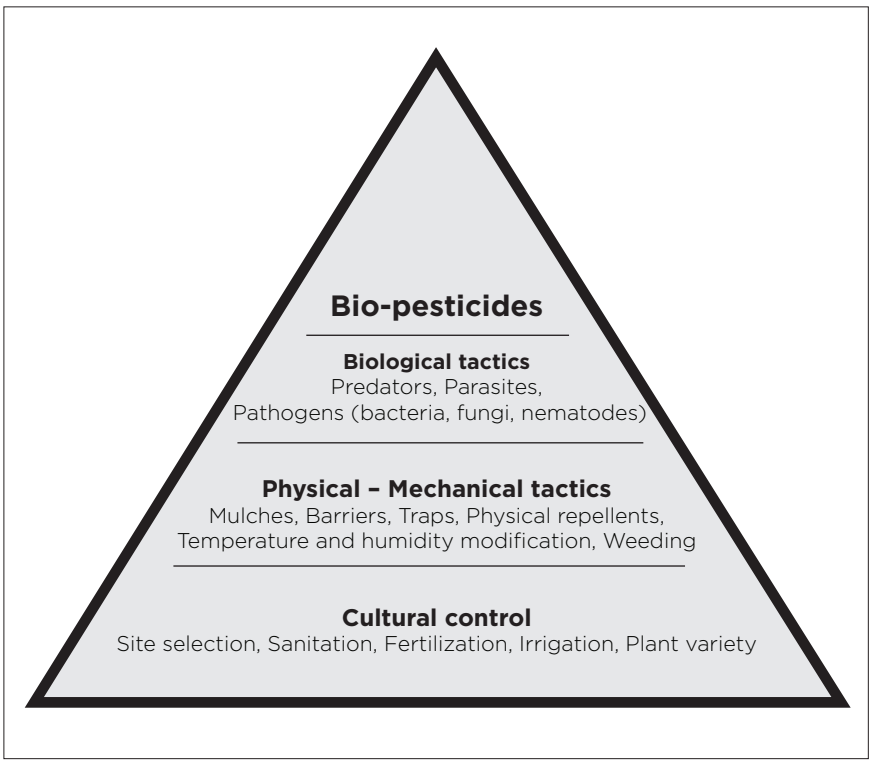

Fig.2. Pyramid of bio-IPM tactics (proactive and reactive options).

injury and action levels are used to help answer such questions as well as to make adequate analysis of the overall situation of a date plantation through agro-ecosystem analysis.

2. Agro–ecosystem analysis (AESA) - The objective of AESA is to build awareness of the relationship that exists between organisms in the environment and to make good management decisions. The AESA should be done weekly to monitor conditions of crop, weather, soil, pests (including diseases and weeds) and beneficial organisms (predators and parasites). To conduct proper AESA, it is highly recommended to spend some time discussing the needed information, observations and recording results. This discussion should lead to the correct way to observe date palm plantation and chosen observed trees. In-field observation of represented sample tree should carefully be observed for the presence of any pests, beneficials, injury symptoms and signs on the different tree parts (growing point, inflorescences, leaves, fruits, trunk/ stem, off shoots, bulb, roots, whole plant). Soil surface also observed for any ground – dwelling pests or beneficials. The results of observed pests and associated organisms, as well as different leaf spot disease symptoms should be recorded on AESA chart (Fig.1A&B) or presented in inspection table or illustrate AESA chart.

3. Proactive tactics of bio-IPM system

Cultural control and pest- resistant cultivars - All agricultural methods should be utilized to create a non-suitable environment for the multiplication of the pest and offer suitable habitat for beneficial organisms. On the other hand cultivars should be resistant to major pest(s), appropriate for the area, commercially available, should have appropriate mode of resistance and must have a market.

Mechanical and physical controls - Methods included in this category utilize some physical components of the environment, such as temperature, humidity, or light, to suppress the pest. Common examples are covering the fruit bunches with plastic nets, flaming, soil solarization, and plastic mulches to kill weeds or to prevent weed seed germination.

Biological control - Biological control is the use of living organisms - parasites, predators, or pathogens - to maintain pest populations below economically-damaging levels, and may be either natural or applied. The first step in setting up a biointensive IPM program is to assess the populations of beneficials and their interactions within the local ecosystem. This will help to determine the potential role of natural enemies in the managed agricultural ecosystem. It should be noted that some groups of beneficials (e.g.,spiders, ground beetles, bats) may be absent or scarce on some farms because of the lack of habitat. These organisms might make significant contributions to pest management if provided with adequate habitat. Possible natural enemies of the main date palm pests are listed in Table (1).

Reactive pest management options

Since, IPM requires continuous assessment of a situation (UIUC, 1997), there are certain key questions that must be answered before implementing any management strategy such as: Is treatment necessary? What

are the alternatives to prohibited substances that can inhibit pests? What are commercial sources for these alternatives? Where should the treatment talk place? When should action be taken? and Which tactics should be used?. The answer of these questions required to emphasize that the mere presence of a pest doesn't necessarily warrant treatment. Some times a fairly large population of pests can be tolerated while other times the presence of a single pest is intolerable. In addition, the determination in treatment will vary among individuals. Also, pest managers must look to the whole system to determine the best place and timing to solve the problem. A successful IPM program is based on taking "a whole system" or eco-system approach to solve a pest problem (Leslie and Cuperus, 1993). We must think of both the living and non-living components when determining which approach to take, and each component has impact on every other component (Altieri, 1994).

Choosing practices/ tactics

Organic control practices for the main pests (i.e. insects, diseases and weeds) are based on non-chemical sanitation, physical, mechanical, cultural, and biological means as well as organically-permitted products including approved chemicals. Since no single practice is effective for all possible pests that threaten the crop, a combination of such practices is necessary. Proactive and reactive practices or tactics should be chosen to achieve the organic control measures (Fig. 2). Steiner, 1994 reported that the proper selection of control techniques is among the bases of successful management of insect pests. During the growing season there are numbers of practices to maintain healthy plants including adequate fertilizing, irrigation and mulch. Preventive devices, sticky colored yellow, black light and pheromone traps are excellent trapping techniques and can be used as survey tools, and may offer protection to plants. These practices could make fields unattractive to pest species. However, sometimes this may be not enough when the levels of pest populations or damage are not acceptable. The use of bio-pesticides including microbial products, botanicals and biochemical substances in these cases are necessary practice. Permitted and restricted pest management tools in organic farming are listed in Table 2.

CONCLUSION

Adoption and overcome of bio-IPM constrains to improve the effectiveness of current programs used in organic date cultivation is needed. Furthermore, new management programs for organic agriculture need to be designed, where the crop environment discourages pest development. Also, the role of training of organic farmers and farm groups should be emphasized as a key feature of successful programs in learning and implementing new practices. Meanwhile the IPM continuum could be achieved according to the following action plan:

1 - Define an appropriate IPM continuum for the country or the region.

2- Establish at what stage we are now.

3 - Establish realistic objectives in consultation with all stakeholders.

4 - Recommended action to industry and to government.

5 - Establish new positions of crop management specialists.

6 - Recruit a professional with research and extension expertise in the area of bio - intensive IPM.

Literature Cited

Al-Azawi, A.F. 1986. A survey of insect pests of date palms in Qatar. Date Palm J. 4:247-266.

Altieri, Miguel A. 1994. Biodiversity and pest management in agro-ecosystems. The Haworth press. Binghamton. NY. 185p.

Azadi, H.; Hosseininia, G.H. and Azadi, M. 2006. 'North-South GM crops transfers and organic farming: The question of food security in South countries'. Paper presented at the International Conference of Economics of Poverty, Environment and Natural Resource Use, 17-19 May 2006, Wageningen, The Netherlands.

Blumberg, D. 2008. Review: Date Palm Arthropod Pests and Their

Management in Israel. Phytoparasitica 36(5):411-448

British Pest Control Association, BPCA. 2002. Pest Control Requirments for Use in Organic Farming & Food Production. Gleneagles House, Vernon Gate, Derby DE11UP.

Calcat, A. 1959. Diseases and pests of date palm in the Sahara and North Africa. Bull. Entomol. Res.11:287-303.

Carpenter, J.B. and Elmer, H.S. 1978. Pests and diseases of the date palm. U.S. Dep. Agric. Agric. Handbk.527:1-42.

Dembilio, Ó. and Jacas, J.A. 2013. Biological Control of Rhynchophorus ferrugineus. AFPP- Palm Pest Mediterranean Conference, NICE- 16-18 January, 2013.

Dhaliwal, G.S. and Heinrichs, E.A. 1998. Critical issues in insect pest management. Commonwealth Publishers, New Delhi, India. 287 pp.

El-Zemaity, M.S. 2006. IPM and organic farming. Arab J. Pl. Prot. Vol.24, No.2:174-176.

El-Zemaity, M.S. 2007a. Developing and using expert systems for management of date palm pests in Arab region- What kinds of information may be needed?. Fourth Symposium on Date Palm in Saudi Arabia Proceedings, King Faisal University, pp:1167-1178.

El-Zemaity, M.S. 2007b. Organic date and bio-intensive IPM . Egypt. J. Agric. Res., 85(1):119-130.

El-Zemaity, M.S. 2013. Future and Challenges of Integration Biotechnology Products in RPW Management Programs. Paper Presented in Fifth Symposium on Date Palm in Saudi Arabia, King Faisal University, Alahsa, 3-5 November 2013.

FAO. 1995. Report of the Expert Consultation on Date Palm - Pest Problems and their control in the Near East. (22-26 April, 1995); Al-Ain, United Arab Emirates.

Freshplaza .Tunisia changing to organic: great demand for dates and fruit. Avaliable in www.freshplaza.com

Fruitrop. 2001. Tunisia: date exports increasing, p.6, n.76, January 2001, Montpellier, France

Guan Soon, L. 1996. Integrated pest management in developing countries. In: Biotechnology and integrated pest management. CAB International, p. 61-75.

Hartmann,M; Khalil, S.; Bernet, T.; Ruhland, F. and Al Ghamdi A. 2012. Organic Agriculture in Saudi Arabia. Available online: www.sofa.org

Hassan, B.H.; Al- Rubeai, H.F.; Al- Jboory, I.J. and Viggiani, G. 2003. Pseudoligosita babylonica n.sp. (Hymenoptera: Trichogrammatidae), egg parasitoid of Ommatissus lybicus Bergevin (Homoptera: Tropiduchidae) in Iraq. Boll. Lab. Ent. Agr. Filippo Silvestri 59: 75-78.

Howard, F.W.; Moore, D.; Giblin-Davis, R.M. and Abad, R.G. 2001. Insects on Palms. CAB International, Wallingford, UK.

Hubaishan, M.A. and Bagwaigo, A.A. 2010. The effect of the egg parasitoid Pseudoligosita babylonica on dobas infestation in Doaan, Shichawi and Asid (Hudramout, Yemen). Proc. 4th Int. Date Palm Conference, Eds.: A. Zaid and G.A.Alhadrami, Acta Hort. 882, ISHS 2010,pp.451-455.

Leslie, Anne R. and Gerritt Cuperus. 1993. Successful implementation of integrated pest management for agricultural crops. CRC Press. Boca Raton, FL. 193p.

Mahmoudi, H; Hosseininia, G.; Azadi, H. and Fatemi, M. 2008. Enhancing Date Palm Processing, Marketing and Pest Control Through Organic Culture. Journal of Organic Systems, Vol.3, No.(2): 29-39.

Naturland e.V. 2002. Organic Farming in the Tropics and Subtropics- Date Palm. – 1st edition, www.naturland.de

Steiner, P.W. 1994. IPM: what it is, what it isn't., IPMnet NEWS. October.

Safwat, M. S. A. 2007. Organic Farming of Date Palm and Recycling of Their Wastes. African Crop Science Conference Proceedings Vol. 8. pp. 2109-2111

United Nations. 2003. Organic Fruit and Vegetables from the Tropics. United Nations Conference on Trade & Development. New York and Geneva.

University of Illinois at Urbana-Champaign, UIUC. 1997. IPM adoption: How far along the continuum are we? http://ipm.uiuc.edu/bulletin/ pastpest/ articles/v9713f.html

Zaid, A.; de Wet, P. F.; Djerbi, M. and Oihabi, A. 2002.Chapter XII: Diseases and Pests of Date Palm. In: A. Zaid (ed.) Date Palm Cultivation. FAO Plant Production and Protection Paper 156. Rev.1. Rome, 2002.