Preface

Date palm, *Phoenix dactylifera* L. (Arecales: Arecaceae), is important to the agrarian economy of several countries in arid regions of the world. Enhanced monoculture of date palm in several date palm growing countries coupled with global warming, unrestrained use of chemical insecticides, and extensive international trade is likely to have an impact on the species diversity and density of pest complex and related natural enemies in the date palm agro-ecosystem. During the last two decades there has been a significant increase in the production area of date palms especially in the Middle East and North Africa, which are the pre-dominant date palm growing regions worldwide. The Food and Agriculture Organization of the UN estimates that there are over 100 million date palms with an annual world's production of nearly 8 million tons. The development of sustainable pest management strategies in date palm is vital to meet the existing and emerging pest challenges.

The crop is attacked by a wide range of insect pests and phytophagous mites, causing serious losses in yield and is some cases death of palm trees. The increase in monoculture plantations of palms during the last two decades has been accompanied by an increase in arthropod pest challenges. Additionally, climate change and large scale movement of palm species for farming and ornamental gardening has also increased the invasive species events compounding the problems of crop protection.

Over the past 20 years those of us living in the temperate zone have been witness to an unprecedented spread of classic pests of palm trees as invasive species. The effect of red palm weevil, in particular, in the greater Mediterranean area has been catastrophic. Iconic palm trees, used largely as ornamentals, are being protected by extraordinary measures including insecticide drenches. This only underscores how unprepared we were for such invasions. It is perhaps a little more difficult to understand how the same species reached the islands of Curaçao and Aruba in the Americas during 2009. In this context the role of pre- and post-entry quarantine regimes is becoming increasingly important in today's world where regional and even intercontinental shipments of planting material have become common.

The responses to events like these are usually the same. First, the invasive species has to be identified, which reminds us of the importance of systematic taxonomy. Moreover, in the modern era, we have learned that a small change in the gut symbiotic population of a given insect can and has changed the whole biology including host choice. Thus insect identification has reached a more complex level and we are forced to adopt microbiological methods. Second, some form of field identification or trapping has to be devised to get accurate information about the location and spread of the invasive species population. Often this response draws from the powerful field of chemical ecology coupled with insect behaviorists. Population biologists can then describe the dynamics of such invasions and economic impact studies can put the event into a wider perspective. Third, some form of pest management must be supplied based on the expertise of economic entomologists. Most often this involves emergency treatment with neurotoxic insecticides to hold back the threat until the sophistication of more sustainable biological control approaches can be brought to bear. All of this is made more complicated by modern views of organic growing, which restrict the types of materials that can be used.

Ideally, over time, invasive species revert to a dynamic balance where control is achieved and life goes on. We have learned of the extreme difficulty of achieving local elimination once an invasive species has become established. Such programs usually involve mass rearing and releases, such as in Sterile Insect Technique strategies, and thus are very expensive, so that, economic impact is the deciding factor.

Renowned palm scientists have comprehensively addressed issues pertaining to the life cycle, damage, losses, geographical distribution, host range and management of major insect pests of date palm of the orders viz. Coleoptera (red palm weevil, long horn beetle, rhinoceros beetle, frond borer, sap beetles), Hemiptera (dubas bug, scale insects), Lepidoptera (lesser date moth, carob moth, raisin moth) and mites. Furthermore, the role of semiochemicals in date palm pest management, innovative methods for managing storage pests of dates and implications of phytoplasmas and their insect vectors in date palm are also discussed. This book on sustainable date palm IPM is intended for farmers, students, researchers and administrators involved in the date palm industry.

We would like to thank all the authors for contributing excellent chapters to this book. We are greatful to Prof. Dr. Aurelio Ciancio, Bari, Italy for including this volume in his book series “Sustainable Plant and Crop Protection”, and for his encouragement and valuable suggestions throughout the project. We extend our thanks to Zuzana Bernhart and Mariska van der Stigchel, Springer Dordrecht, The Netherlands for their facilitation in successful production of this book.

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Preface

This is the second Volume of the Series *Sustainability in Plant and Crop Protection* (SUPP). The series presents each year a topic coverage dedicated to a specific theme, examined in a perspective related to crops sustainability. In particular, it targets issues in plant and crop protection, including not only innovative approaches and data in pest and disease control but also the management of biotic and abiotic stresses. This second volume affords the study of protection in date palm productions and has been produced thanks to the endless efforts and detailed studies provided by its editors, Dr. Waqas Wakil, Dr. Jose R. Faleiro, Dr. Thomas A. Miller and by all the other contributing authors.

Date palm is a challenging crop, not only for the large number of pests that attack dates and stored fruits but also for the peculiar traits of the environment in which productions take place, the dimension of the palm trees and the complexity of the cropping cycles.

It is, furthermore, a very ancient crop. Date palm domestication may be tracked back to the 5th millennium B.C. when, after its likely adoption from wild ancestors, it largely contributed to the success of agriculture in desert or semi-arid environments, otherwise unsuitable for human settlement. Date palm groves provided stable sources of sugars and vitamins and have been integrated with other fruit trees like fig, grape, apple or pomegranate, shaded in various layers under the palm fronds in the cultivated gardens. Cereals, vegetables and pulses were often present in the groves, thus integrating farmers' diet and contributing to the development of agricultural and selection practices.

Date palm is also one early example of irrigated crop, a practice which in turn contributed to the development of ducts, wells or canals, with related machineries and technologies. Irrigation can be dated back to the 3rd millennium to become fully established by the 1st millennium B.C. This crop, hence, largely sustained for several millennia the agriculture and landscape of the desert or peri-fluvial oasis or environments, in a wide territory ranging from North Africa and Middle East to Central Asia. Furthermore, the palm has an overall symbolic meaning, not only because of its intrinsic symmetry and ornamental beauty but also for its historical

role in providing food for many societies and settlements, as well as for shaping the art, culture and traditions of many people.

It is hence with interest that the reader may look at this volume. It provides comprehensive reviews of main pests and parasites of date palm, of their impacts and of the possible control solutions adopted in different regions of the globe, including the Americas. Many of the palm threats result by a wide array of insect pests which are listed, described and illustrated in several chapters. The recent outbreak of the red palm weevil, *Rhynchophorus ferrugineus*, in the Mediterranean regions, is just one of the many examples of major threats examined in detail.

Although many measures applied still consider the application of synthetic pesticides, a number of studies and assays dealing with other, more sustainable control practices including biological, physical or non-chemical approaches are also discussed. These options require an increase in the production of knowledge, and in many cases future research guidelines are indicated. In particular, these also consider the substitution of the use of pesticides by information-based and more resource-conservative approaches.

The production of new data on the ecology, taxonomy and genetics of pests as well as on the cultural or management aspects of date palm represents, indeed, a challenge for the years to come. The volume, hence, contributes to present, organize and discuss key aspects of the actual sustainability issues of this crop. The amount of information provided is impressive, with a vast bibliography, updating actual knowledge through the research data produced by the field work and experience of the authors who represent a leading edge in the field, either for their experience or comprehensive contributions.

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