

BURLEIGH DODDS SERIES IN AGRICULTURAL SCIENCE

# Rice insect pests and their management

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# Introduction

Rice, the daily food of nearly half of the world's population, is the foundation of national stability and economic growth in many developing countries. It is the source of one-quarter of global food energy and – for the world's poor – the largest food source. It involves also the single largest use of land for producing food and the biggest employer and income generator for rural people in the developing world. Rice production has been described as the single most important economic activity on Earth. Because rice occupies approximately 9% of the planet's arable land, it is also a key area of concern – and of opportunity – in environmental protection.

Rice, one of the world's major food crops, has a variety of uses and is adapted to a broad range of climatic, edaphic and cultural conditions. Annual world rice production in 2013 was approximately 745 million tonnes grown on more than 165 million ha (FAO 2016). Over 90% of this area lies in Asia, while the remainder is divided among Latin America, Africa, Australia, Europe and the United States. Annual production in Asia is 675 million tonnes while it is only 36 million tonnes in the Americas and 29 million tonnes in Africa.

Rice cultivation involves the dominant land use in Asia, but it is now playing an increasingly important role in Africa as well. In West and Central Africa – the most impoverished regions on Earth according to the Food and Agriculture Organization (FAO) – rice is grown under subsistence conditions by about 20 million smallholder farmers who are shackled to slash-and-burn farming and who lack rice varieties that are appropriate to local conditions. FAO statistics show that the demand for rice in these regions is growing by 6% a year (the fastest-growing rice demand in the world), largely because of increasing urbanisation. The increase in rice consumption is not only limited to Africa but also prevalent worldwide.

To feed the growing world population rice production must be increased. However, rice farmers face many abiotic and biotic constraints in their quest to increase rice production. In conjunction with the introduction of new high-yielding drought- and flood-tolerant rice varieties, increasing yields will require a reduction in losses to insects and other stresses. As cropping intensity and cultural practices are changed to meet production needs, pest pressure is expected to intensify.

The rice plant is an ideal host for many insect species. All of the plant parts are vulnerable to insect attack from the time of sowing till harvest. There are over 800 insect species damaging rice in one way or another, although the majority of them do very little damage. In tropical Asia only about 20 species are of major importance and of regular occurrence (Grist and Lever 1969). In Africa, 15 species of insects are considered major pests of rice (Oteng and Sant'Anna 1999) and in the Americas about 20 species are considered major pests (Stout, pers. comm.).

To develop effective pest management strategies, it is essential to properly identify and to understand the biology and ecology of insect pests and the arthropods that help regulate their populations. This chapter effectively utilises the unique knowledge and expertise of leading rice entomologists from Africa, Asia and the Americas to provide the first global coverage of rice insect pests. The discussion includes the geographical distribution, plant hosts other than rice, description and biology, and plant damage and ecology of the important rice insects in Africa, Asia and the Americas.

The insects are classified based on feeding type: (1) root and stem feeders, (2) stem borers, (3) rice gall midges, (4) leafhoppers and planthoppers, (5) foliage feeders and

(6) panicle feeders. In addition, the current strategies to manage rice insect pests in an environmentally sustainable manner are discussed.

## References

- FAO. 2016. FAOSTAT. <http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor>
- Grist, D. H. and Lever, R. J. A. W. 1969. *Pests of Rice*. London and Harlow: Longmans, Green and Co. Ltd.
- Oteng, J. W. and Sant'Anna, R. 1999. Rice production in Africa: current situation and issues. In *International Rice Commission Newsletter*, Vol. 48. FAO, Roma.

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