Rice insect pests and their management

Professor Elvis A. Heinrichs, Dr Francis E. Nwilene, Professor Michael Stout, Dr Buyung A. R. Hadi and Dr Thais Freitas
## Contents

Series list ix  
Introduction xiii  

### 1 Biology and ecology of rice-feeding insects: root and stem feeders  
E. A. Heinrichs, University of Nebraska-Lincoln, USA; F. E. Nwilene, The Africa Rice Center (AfricaRice), Nigeria; M. Stout, Louisiana State University, USA; B. A. R. Hadi, International Rice Research Institute (IRRI), The Philippines; and T. Freitas, Universidade Federal do Rio Grande do Sul, Brazil  

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Mole cricket</td>
<td>3</td>
</tr>
<tr>
<td>1.3 Root aphids</td>
<td>5</td>
</tr>
<tr>
<td>1.4 Rice root aphid</td>
<td>8</td>
</tr>
<tr>
<td>1.5 Rice mealybug</td>
<td>10</td>
</tr>
<tr>
<td>1.6 Black bugs</td>
<td>12</td>
</tr>
<tr>
<td>1.7 Rice stalk stink bug</td>
<td>15</td>
</tr>
<tr>
<td>1.8 Chinch bug</td>
<td>17</td>
</tr>
<tr>
<td>1.9 Rice seed midges</td>
<td>19</td>
</tr>
<tr>
<td>1.10 Rice stem maggot</td>
<td>22</td>
</tr>
<tr>
<td>1.11 Rice seedling flies</td>
<td>23</td>
</tr>
<tr>
<td>1.12 Black beetles</td>
<td>25</td>
</tr>
<tr>
<td>1.13 ‘Chafers’ (white grubs)</td>
<td>26</td>
</tr>
<tr>
<td>1.14 Colaspis beetles</td>
<td>28</td>
</tr>
<tr>
<td>1.15 Rice root weevil</td>
<td>31</td>
</tr>
<tr>
<td>1.16 Rice plant weevil</td>
<td>33</td>
</tr>
<tr>
<td>1.17 Paddy root weevil</td>
<td>35</td>
</tr>
<tr>
<td>1.18 Rice water weevil</td>
<td>37</td>
</tr>
<tr>
<td>1.19 Gorgulho aquático do arroz</td>
<td>41</td>
</tr>
<tr>
<td>1.20 Rice water weevil</td>
<td>43</td>
</tr>
<tr>
<td>1.21 Termites</td>
<td>44</td>
</tr>
<tr>
<td>1.22 Root-feeding termites</td>
<td>49</td>
</tr>
<tr>
<td>1.23 References</td>
<td>51</td>
</tr>
</tbody>
</table>

### 2 Biology and ecology of rice-feeding insects: stem borers and rice gall midges  
E. A. Heinrichs, University of Nebraska-Lincoln, USA; F. E. Nwilene, The Africa Rice Center (AfricaRice), Nigeria; M. Stout, Louisiana State University, USA; B. A. R. Hadi, International Rice Research Institute (IRRI), The Philippines; and T. Freitas, Universidade Federal do Rio Grande do Sul, Brazil  

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Introduction</td>
<td>57</td>
</tr>
<tr>
<td>2.2 Stalk-eyed borer</td>
<td>61</td>
</tr>
<tr>
<td>2.3 Stalk-eyed fly</td>
<td>65</td>
</tr>
<tr>
<td>2.4 Gold-fringed rice borer</td>
<td>68</td>
</tr>
<tr>
<td>2.5 Dark-headed stem borer</td>
<td>70</td>
</tr>
<tr>
<td>2.6 Spotted stem borer</td>
<td>73</td>
</tr>
<tr>
<td>2.7 American rice stalk borer</td>
<td>76</td>
</tr>
<tr>
<td>2.8 Rice striped borer</td>
<td>79</td>
</tr>
<tr>
<td>2.9 African striped rice borer</td>
<td>83</td>
</tr>
</tbody>
</table>

© Burleigh Dodds Science Publishing Limited, 2017. All rights reserved.
3 Biology and ecology of rice-feeding insects: leafhoppers and planthoppers

E. A. Heinrichs, University of Nebraska-Lincoln, USA; F. E. Nwilene, The Africa Rice Center (AfricaRice), Nigeria; M. Stout, Louisiana State University, USA; B. A. R. Hadi, International Rice Research Institute (IRRI), The Philippines; and T. Freitas, Universidade Federal do Rio Grande do Sul, Brazil

3.1 Introduction 135

3.2 White rice leafhoppers 138

3.3 Green leafhoppers 140

3.4 Nephotettix afer Ghauri and Nephotettix modulatus Melichar 141

3.5 Nephotettix nigropictus (Stål) 143

3.6 Nephotettix cincticeps (Uhler) 145

3.7 Nephotettix virescens (Distant) 147

3.8 Nephotettix malayanus Ishihara et Kawase 149

3.9 Zigzag leafhopper 151

3.10 Smaller brown planthopper (Laodelphax striatellus Fallen) 153

3.11 Brown planthopper (Nilaparvata lugens Stål) 155

3.12 White-backed planthopper 160

3.13 Rice delphacid (Tagosodes orizicolus Muir) 164

3.14 Rice delphacid (Tagosodes cubanus Crawford) 167

3.15 Spittlebugs (Locris maculata maculata Fabricius) 169

3.16 Spittlebugs (Deois flavopicta Stål) 172

3.17 References 174

4 Biology and ecology of rice-feeding insects: foliage feeders

E. A. Heinrichs, University of Nebraska-Lincoln, USA; F. E. Nwilene, The Africa Rice Center (AfricaRice), Nigeria; M. Stout, Louisiana State University, USA; B. A. R. Hadi, International Rice Research Institute (IRRI), The Philippines; and T. Freitas, Universidade Federal do Rio Grande do Sul, Brazil

4.1 Introduction 181

4.2 Large rice grasshoppers (Hieroglyphus banian Fabricius) 186

4.3 Rice grasshopper (Hieroglyphus daganensis Krauss) 189

4.4 Short-horned grasshoppers 191

4.5 Variegated grasshoppers 193

4.6 Meadow grasshoppers 196

4.7 Whitefly 199
4.8 Rice whitefly 201
4.9 Spider mites 202
4.10 Rice thrips 204
4.11 Rice leaffolder (Cnaphalocrocis medinalis Guenée) 207
4.12 Rice leaffolder (Marasmia patnalis Bradley) 212
4.13 Fijian rice leaffolder 214
4.14 Rice caseworm 215
4.15 Green horned caterpillar 218
4.16 Rice skipper (Parnara guttata Bremer et Grey) 221
4.17 Rice skipper (Pelopidas mathias F.) 223
4.18 Rice ear-cutting caterpillar 225
4.19 The fall armyworm (Spodoptera frugiperda J. E. Smith) 228
4.20 Common cutworm 230
4.21 Rice swarming caterpillar 232
4.22 Common armyworm (Mythimna unipuncta Haworth) 235
4.23 Rice green semi-loopers 237
4.24 Green hairy caterpillars 240
4.25 Rice whorl maggot (Hydrellia prosternalis Deeming) 242
4.26 Rice leaf miner (Hydrellia griseola Fallen) 244
4.27 Rice whorl maggot (Hydrellia philippina Ferino) 247
4.28 South American rice miner 251
4.29 Leaf miner (Cerodontha orbitona Spencer) 254
4.30 Paddy stem maggot 255
4.31 Asian rice hispa 257
4.32 African rice hispa 261
4.33 Rice blue beetle 264
4.34 Rice leaf beetle 266
4.35 Flea beetles 268
4.36 Ladybird beetle 271
4.37 Foliage feeding aphids 273
4.38 References 274

5 Biology and ecology of rice-feeding insects: panicle feeders 285

E. A. Heinrichs, University of Nebraska-Lincoln, USA; F. E. Nwilene, The Africa Rice Center (AfricaRice), Nigeria; M. Stout, Louisiana State University, USA; B. A. R. Hadi, International Rice Research Institute (IRRI), The Philippines; and T. Freitas, Universidade Federal do Rio Grande do Sul, Brazil

5.1 Introduction 285
5.2 Stink bugs 287
5.3 Alydid bugs 288
5.4 Rice bugs 293
5.5 Stink bugs 299
5.6 Southern green stink bug 301
5.7 Rice stink bugs 303
5.8 Earwigs 309
5.9 Blister beetles 311
5.10 Panicle thrips 313
5.11 References 315
6 Integrated pest management (IPM) of rice 319
   E. A. Heinrichs, University of Nebraska-Lincoln, USA; F. E. Nwilene, The Africa Rice Center (AfricaRice), Nigeria; M. Stout, Louisiana State University, USA; B. A. R. Hadi, International Rice Research Institute (IRRI), The Philippines; and T. Freitas, Universidade Federal do Rio Grande do Sul, Brazil
   6.1 Concepts and options for rice IPM 319
   6.2 Cultural practices in rice IPM 321
   6.3 Promoting natural enemies of rice pests: conservation biological control 325
   6.4 Augmentative biological control 328
   6.5 Selective insecticides 329
   6.6 Dissemination mechanisms for rice IPM 332
   6.7 References 335

Index 345
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


Index

African pink borer 97–100
African rice gall midge 120–124
African rice hispa 263–266
African striped rice borer 83–85
African subterranean termites 44–48
African white borer 86–90
Alydid bugs 291–294
American rice stalk borer 76–78
Asian rice gall midge 116–119
Asian rice hispa 259–262
Asiatic pink stem borer 102–104
Augmentative biological control 330–331
Black beetles 25–26
Black bugs 12–14
Blister beetles 313–314
Brown planthopper 155–159
'Chafers' (white grubs) 26–28
Chinch bug 17–18
Colaspis beetles 28–30
Common armyworm 237–238
Common cutworm 232–233
Dark-headed stem borer 70–72
Earwigs 311–312
Economic action thresholds 331–332
Fall armyworm 230–231
Farmer field school (FFS) 334–336
Fertilizer management 324–325
FFS. see Farmer field school (FFS)
Fijian rice leaffolders 216
Flea beetles 270–272
Foliage feeders
  African rice hispa 263–266
  Asian rice hispa 259–262
  common armyworm 237–238
  common cutworm 232–233
  fall armyworm 230–231
  flea beetles 270–272
  foliage feeding aphids 275
  green hairy caterpillars 242
  green horned caterpillar 220–222
  ladybird beetle 273–274
  large rice grasshoppers 188–190
  leaf miner 256
  meadow grasshoppers 198–200
overview 146–148
paddy stem maggot 257–258
rice blue beetle 266–267
rice caseworm 217–219
rice ear-cutting caterpillar 227–229
rice grasshoppers 188–190
rice green semiloopers 239–241
rice leaf beetle 268–269
rice leaffolders 214–215
  Fijian 216
rice leaf miner 246–248
rice skipper 223–224
rice swarming caterpillar 234–236
rice thrips 206–208
rice whitefly 203
rice whorl maggot 244–245, 249–252
short-horned grasshoppers 193–194
South American rice miner 253–255
spider mites 204–205
variegated grasshopper 195–197
  whitefly 201–202
Foliage feeding aphids 275
Gold-fringed rice borer 68–69
Green hairy caterpillars 240
Green horned caterpillar 218–219
Green leafhoppers 140–141
Habitat management 327–328
Host plant resistance 321–323
Insecticide resistance 331
Insect population dynamics 325–326
Integrated pest management (IPM)
  augmentative biological control 330
  dissemination mechanisms for 334–336
  fertilizer management 324–326
  habitat management 329
  host plant resistance 323–324
  insect population dynamics 327–328
  natural pest regulation 327–331
  overview 253–254
  selective insecticides
    economic action thresholds 331–332
    insecticide resistance 333
    selectivity against natural enemies 332
  Ladybird beetle 273–274
  Large rice grasshoppers 188–190
LCB. see Lesser cornstalk borer (LCB)

Leafhoppers and planthoppers
- brown planthopper 155–159
- green leafhoppers 140–141
- Nephotettix afer Ghauri 141–143
- Nephotettix cincticeps 145–147
- Nephotettix malayanus 149–151
- Nephotettix modulatus Melichar 141–143
- Nephotettix nigropictus 143–145
- Nephotettix virescens 147–150

overview 107–109
- rice delphacid 164–167
- smaller brown planthopper 153–155
- spittlebugs 169–172
- white-backed planthopper 160–163
- white rice leafhoppers 138–140
- zigzag leafhopper 151–152

Leaf miner 254–256

Lesser cornstalk borer (LCB) 110–113

Mass media campaign (MMC) 332–334
Meadow grasshoppers 196–198
Mexican rice borer 113–115
MMC. see Mass media campaign (MMC)
Mole cricket 3–5

Natural pest regulation 325–326
Nephotettix afer Ghauri 141–143
Nephotettix cincticeps 145–147
Nephotettix malayanus 149–151
Nephotettix modulatus Melichar 141–143
Nephotettix nigropictus 143–145
Nephotettix virescens 147–150

Oryzophagus oryzae 41–43

Paddy root weevil 35–36
Paddy stem maggot 255–257
Panicle thrips 313–315
Pecky rice 286

Rice blue beetle 266–267
Rice bugs 295–300
Rice caseworm 217–219
Rice delphacid 164–168
Rice ear-cutting caterpillar 227–229
Rice grasshoppers 188–190
Rice green semiloopers 239–241
Rice leaf beetle 268–269
Rice leafhoppers 214–215
Fijian 216
Rice leaf miner 246–248

Rice mealybug 10–11
Rice panicle feeders
- alydid bugs 291–294
- blister beetles 313–314
- earwigs 311–312
- overview 227–228
- panicle thrips 315–316
- rice bugs 295–300
- rice stink bugs 305–310
- southern green stink bug 303–304
- stink bugs 289, 301–302

Rice plant weevil 33–34
Rice root weevil 31–32
Rice seedling flies 23–24
Rice seed midges 19–21
Rice skipper 221–223
Rice stalk stink bug 15–16
Rice stem borers and gall midges
- African pink borer 97–100
- African rice gall midge 120–124
- African striped rice borer 83–85
- African white borer 86–90
- American rice stalk borer 76–78
- Asian rice gall midge 116–119
- Asiatic pink stem borer 102–104
- dark-headed stem borer 70–72
- gold-fringed rice borer 68–69
- lesser cornstalk borer (LCB) 110–112
- Mexican rice borer 113–115
- overview 44–46
- rice striped borer 79–82
- South American white borer 105–107
- spotted stem borer 73–75
- stalk-eyed borer 61–64
- stalk-eyed fly 65–67
- sugarcane borer 107–109
- white stem borer 95–97
- yellow stem borer 91–95

Rice stem maggot 22–23
Rice stink bugs 305–310
Rice striped borer 79–82
Rice swarming caterpillar 232–234
Rice thrips 204–207
Rice water weevil 37–39, 43–44
Rice whitefly 160–161
Rice whorl maggot 242–243, 195–198
Root and stem feeders
- African subterranean termites 44–48
- black beetles 25–26
- black bugs 12–15
- ‘chafers’ (white grubs) 26–28
- chinch bug 17–18
Index

colaspis beetles 28–30
mole cricket 3–5
Oryzophagus oryzae 41–43
overview 2
paddy root weevil 35–36
rice mealybug 10–11
rice plant weevil 33–34
rice root weevil 31–32
rice seedling flies 23–24
rice seed midges 19–21
rice stalk stink bug 15–16
rice stem maggot 22–23
rice water weevil 37–39, 43–44
root aphids 5–8
South American root-feeding termites 49–50
Root aphids 5–8
Selective insecticides
economic action thresholds 331–332
insecticide resistance 331
selectivity against natural enemies 332
Short-horned grasshoppers 193–194
Smaller brown planthopper 153–155
South American rice miner 253–255
South American root-feeding termites 49–50
South American white borer 105–107
Southern green stink bug 303–304
Spider mites 204–205
Spittlebugs 169–172
Spotted stem borer 73–75
Stalk-eyed borer 61–64
Stalk-eyed fly 65–67
Stink bugs 289, 301–302
Stink bugs 289
Sugarcane borer 107–109
Variegated grasshopper 195–197
White-backed planthopper 160–163
Whitefly 201–202
White rice leafhoppers 138–140
White stem borer 95–97
Yellow stem borer 91–95
Zigzag leafhopper 151–152