INTEGRATED PEST MANAGEMENT (IPM) STRATEGIES FOR NERICA VARIETIES

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Unit 1 – Major insect pests of rice

Table 18 summarizes the major insect pests of rice, which cause yield losses from 10–100% in farmers' fields in some West African countries (Nacro *et al.*, 1996; Ukwungwu *et al.*, 1989). Attempts to help rice farmers reduce the damage caused by these pests is a major challenge to agricultural researchers in West Africa.

Table 18. Distribution and host range of economically-important stem borers of rice in West Africa

Common name	Species	Order: Family	Distribution	Host range
Pink stalk borer	*Sesamia calamistis* Hampson	Lepidoptera: Noctuidae	Cameroon, The Gambia, Ghana, Côte d'Ivoire, Niger, Nigeria	Rice, maize, sorghum, wheat, millet, sugar cane, wild grasses
Pink stalk borer	*Sesamia nonagrioides botanephaga* Tams & Bowden	Lepidoptera: Noctuidae	Ghana, Côte d'Ivoire, Nigeria	Rice, maize, sorghum, wheat, millet, sugar cane, wild grasses
Pink stalk borer	*Sesamia penniseti* Tams and Bowden	Lepidoptera: Noctuidae	Ghana, Côte d'Ivoire, Nigeria	Rice, maize, sorghum, wheat, millet, sugar cane, wild grasses

Pink stalk borer	*Sesamia poephaga* Tams and Bowden	Lepidoptera: Noctuidae	Nigeria	Rice, maize, sorghum, wheat, millet, sugar cane, wild grasses
Striped stem borer	*Chilo zacconius* Bleszynski	Lepidoptera: Crambidae	Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Mali, Niger, Nigeria, Senegal, Sierra Leone	Rice, sorghum, *Echinochloa crus-galli*, *Pennisetum* spp.
Yellow stem borer	*Scirpophaga melanoclista* Meyrick	Lepidoptera: Crambidae	Cameroon, Côte d'Ivoire, Mali, Nigeria, Senegal	Rice
Yellow stem borer	*Scirpophaga subumbrosa* Meyrick	Lepidoptera: Crambidae	Ghana, Mali	Rice
African white borer	*Maliarpha separatella* Ragonot	Lepidoptera: Pyralidae	Côte d'Ivoire, Mali, Nigeria	Cultivated and wild rices (*Oryza barthii*, *O. longistaminata*, *O. punctata*)

Stalk-eyed flies	*Diopsis longicornis* Macquart, *Diopsis apicalis* Dalman, *Diopsis collaris* Westwood	Diptera: Diopsidae	Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo	Rice, sorghum, millet, *Cynodon dactylon*, *Cyperus difformis*, *Paspalum orbiculaire*
African rice gall midge	*Orseolia oryzivora* Harris & Gagné	Diptera: Cecidomyiidae	Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, Malawi, Tanzania, Uganda and Zambia	*Oryza sativa*, *O. glaberrima*, interspecific progenies, wild species (*O. longistaminata*, *O. barthii*, *O. punctata*, *O. stapfii*)

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Unit 2 – Major Components in Integrated Pest Management (IPM) Strategies

Background information

Integrated pest management (IPM) is particularly relevant to subsistence agriculture. It is environmentally safe, socially acceptable, economically feasible, and compatible with other non-disruptive pest control methods. IPM options include varietal resistance/tolerance, biological control and cultural practices.

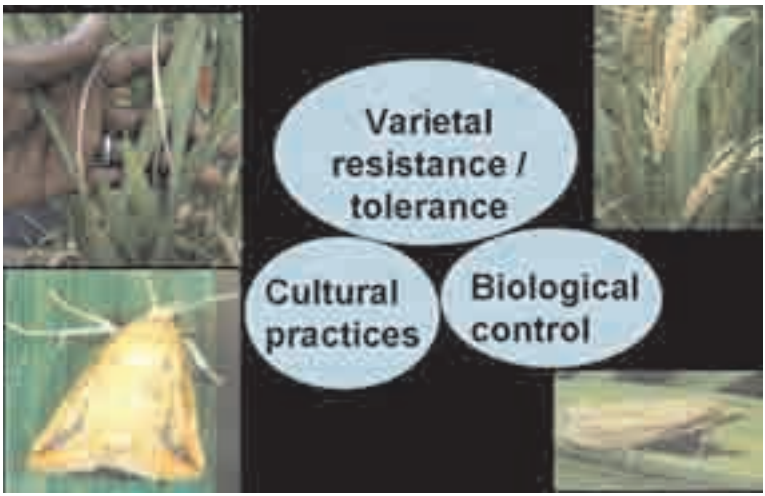

Figure 22. Symptoms of rice stem borer damage and components of IPM strategies

1. Varietal resistance/tolerance

Key Issues: stem borers/termites

- Rice mixed with maize is a common feature of traditional upland rice cultivation

- Can maize be used as a trap crop to protect rice against stem borers?
- Can traditional management practices for termites be integrated with botanicals

Objective	Methodology	Results
To evaluate management components for rice stem borers in rice-based systems	Strip-cropping maize with 19 NERICA varieties in alternate rows, direct seeded, RCB design with 3 replications	There was less stem borer damage on NERICA lines than on maize (Interspecific Hybridization Program IHP Report 2000)
To evaluate management component for termites in rice fields	NERICA1–7, LAC 23, OS 6, Furadan mixed with gari, neem oil, powder, ripe pawpaw mixed with red palm oil; split plot design with 3 replications	Furadan and gari, and neem seed oil, gave the best protection. NERICA5 was the least attacked (Nwilene *et al*., working paper, WARDA)

1.1 Stem borers

Background information

Resistant varieties are an important component of integrated pest management. Most of the traditional *Oryza sativa* varieties grown in Africa are low yielding and highly susceptible to stem borers. Are NERICA varieties more or less vulnerable to stem borer damage than their parents or other landraces? What is the level of resistance or tolerance to stem borers among the named NERICA varieties?

Highlights

- To what extent might NERICA varieties be resistant or vulnerable to stem borer damage?

Stem borer pressure may greatly vary across locations and years, attributable to differences in agroclimatic conditions or crop management factors. Thus, NERICA lines have varying levels of resistance to stem borers across locations as summarized below.

Objective	Methodology	Results
To identify upland NERICA varieties with resistance / tolerance to stem borers in West Africa	NERICA1–7, LAC 23, IDSA 6 were direct seeded in a RCB design with 3 replications in Côte d'Ivoire between 2001–2002	NERICA 4 was resistant to stem borers in Côte d'Ivoire (Rodenburg *et al.*, 2006)
	NERICA1–7, LAC 23, OS 6; direct seeded; RCB design with 3 replications in Nigeria between 2004–2005	NERICA1 and 5 were resistant to stem borers in Nigeria (Rodenburg *et al.*, 2006)

In Côte d'Ivoire, West Africa, NERICA4 was found to be resistant to rice stem borers

During the 2001 wet season and under natural infestation at M'bé (Bouaké) in the derived savanna and at Boundiali in the Guinea Savanna, the interspecific WAB 450-1-B-P-133-HB was reported to be the least attacked at both locations.

In Boundiali, NERICA2, NERICA4 and NERICA7 showed less stem borer damage than NERICA1 and NERICA6 as well as the widely-grown susceptible variety check (IDSA 6).

At M'bé, however, the same NERICA varieties (NERICA1, NERICA2, NERICA4, NERICA6 and NERICA7) had more stem borer deadhearts than the susceptible check. WAB450-1-B-P-133-HB was rated moderately resistant in Boundiali. At M'bé, however, it was rated moderately susceptible.

In Nigeria, West Africa, NERICA1 and NERICA5 were rated under field conditions as the most tolerant to rice stem borers, with infestation levels of less than 10 percent.

At Ikenne, under field infestation during the 2005 wet season there was no significant difference in deadhearts between NERICA1, NERICA2, NERICA5 and the resistant local variety check (LAC 23) at 60 days after sowing (DAS). At 90 DAS, NERICA5 was significantly different from the other varieties (NERICA1, NERICA2, NERICA3, NERICA4, NERICA6 and NERICA7). NERICA6 was not significantly different from the susceptible check. NERICA1 and NERICA5 had less than 10% tiller infestation (bored stems) and were rated as the most resistant varieties at Ikenne during the 2005 wet season.

Three lepidopterous borers, *Sesamia botanephaga, Chilo zacconius* and *Maliarpha separatella*, were the predominant species on the NERICA varieties. The dipterous stalk-eyed borers, *Diopsis longicornis* and *D. apicalis*, occurred in the field when the NERICA rice crop was at the early vegetative stage of growth.

1.2 Termites

NERICA5 was found to be less susceptible to termite damage even when unprotected. NERICA2 and NERICA3 also show a degree of tolerance to termite.

During the course of the experiments Microtermes was the predominant termite species in the field, followed by Ancistrotermes, and Odontotermes.

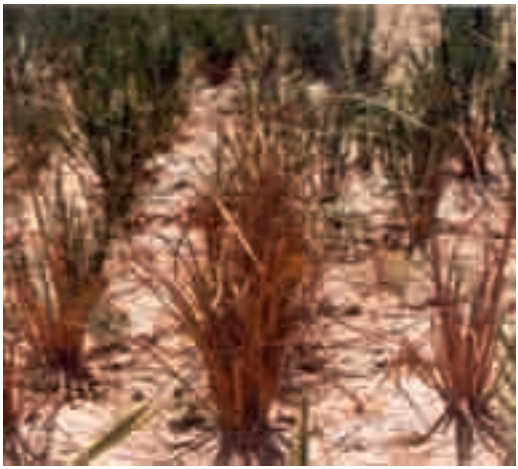

Figure 23. Symptoms of termite attack on rice

1.3 African rice gall midge (AfRGM)

Background information

The NERICA varieties have been developed for production in upland systems. Nevertheless, in view of their desirable qualities, they have been evaluated for adaptability and resistance to the AfRGM, which is rather a serious pest of rainfed and irrigated lowland rice in SSA.

Damage by AfRGM is different from that of other stem borer species because the larvae attack the growing points of rice tillers at the vegetative stage (seedling to panicle initiation). Infestation of a tiller prevents panicle production and results in the development of a tubular gall—also known as 'onion leaf' or 'silver shoot'.

In spite of the hundreds of screenings of *O. sativa* accessions, very little progress has been made in identifying good donor material with stable resistance to AfRGM. Two Asian *O. sativas* – Cisadane (from Indonesia) and BW 348-1 (from Sri Lanka) – have been selected as varieties tolerant to AfRGM at WARDA. The former was released as FARO 51 in Nigeria in 1998 and the latter was released in Burkina Faso. One disadvantage of Cisadane is that it is rather sensitive to iron toxicity. BW 348-1 has good tolerance to AfRGM and iron toxicity under lowland field conditions. A high-yielding *O. sativa* with strong resistance to AfRGM is not yet available. Many varieties resistant to Asian rice gall midge, *Orseolia oryzae* Wood-Mason, are susceptible to AfRGM.

Highlights

In the 2003 and 2004 wet seasons, 10 interspecific lines from WARDA were evaluated for resistance to AfRGM under natural infestation at two hot-spot locations in Nigeria (Ikwo, southeast and Bida, central Nigeria).

At Ikwo, WAB 875-23AB.1 had the lowest mean plant damage when compared with the resistant check variety TOS 14519.

At Bida, WAB 875-23AB.1, WAB 875-19AB.1 and WAB 875-23AB.2 performed the best among the lines tested.

Earlier, a team of researchers from WARDA and NARS from Burkina Faso, Mali, Nigeria and Sierra Leone identified an interspecific progeny, WAB 450-1-B-P181-22-1-HB, with strong resistance to AfRGM (Williams *et al*., 2001).

The glaberrima parent of the NERICAs (CG 14) and many other accessions of *O. glaberrima*, have been found resistant to AfRGM (Nwilene *et al*., 2002) but none of the NERICA varieties has been identified as resistant.

Biological control is an important component of IPM for control of the AfRGM.

2. Cultural practices

Which cropping system incorporating NERICA varieties is most sensitive to rice stem borers?

Background information

Rice mixed with maize (*Zea mays* L.) is a common feature of traditional upland rice cultivation in many West African countries. Maize and rice share some common stem borer species. To what extent might NERICA-maize intercropping influence stem borer activity (infestation, crop damage, species composition)? Can the NERICA varieties be intercropped with maize for more efficient management of stem borers under upland conditions? Can maize be used as a trap crop to protect rice against stem borers?

Highlights

- Intercropping has high potential as a cultural method of controlling the major stem borers on rice
- Maize (*Zea mays* L.) can be a suitable trap crop for NERICA1 and NERICA4 stem borers
- There were fewer deadhearts on NERICA4 cropped with maize than on rice or maize monocultures at M'bé and Boundiali in Côte d'Ivoire, West Africa.
- Strip cropping of four rows of maize alternating with an equal number of NERICA rows was found to be effective in reducing stem borer damage on NERICA varieties. NERICA4 had the lowest number of larvae per plant, followed by the interspecific

lines WAB 880-1-38-19-8-P2-HB and WAB 450-1-B-P-105-HB. The added advantages of strip cropping are improved yields and ease of field operations.

During the course of the experiments *Eldana saccharina* was the predominant stem borer on maize (90%), followed by *Maliarpha separatella* (5%), *Sesamia calamistis* (3%), *Chilo zacconius* (1%), and *Busseola fusca* (1%). Stem borers on rice were *Eldana saccharina* (58%), *Maliarpha separatella* (26%), *Sesamia calamistis* (6%), *Chilo zacconius* (5%), *Diopsis longicornis* (4%) and *Busseola fusca* (1%).

3. Biological control of AfGRM

Background information

Two common parasitoid species, including *Platygaster diplosisae* and *Aprostocetus procerae,* are common natural enemies of AfRGM. These parasitoids also attack a related gall midge species, which thrives on *Paspalum scrobiculatum* but does not attack rice.

Highlights

Planting Paspalum at the edges of rice fields attracts Paspalum gall midge, which harbors parasitoids. These parasitoids then attack the AfRGM. Planting paspalum around the edges of rice fields and planting varieties moderately resistant to AfRGM such as BW 348-1 and Cisadane may reduce the damage caused this pest.