

Management Matters in the War against Stemborers and Striga

MARSHALLING PLANT DEFENSES IN BATTLE FOR SURVIVAL



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Nature has provided plants with an array of defense mechanisms to help them compete in the never-ending conflict for one's own turf or biological niche in this world and the right to grow and multiply. The Nairobi-based International Centre of Insect Physiology and Ecology (ICIPE) is putting the tug-of-war between cereal crops and their enemies (plant pests) to good use to control stemborers, the major pests of maize in eastern and southern Africa. Losses to stemborers can reach as high as 80% in some areas, and average about 15-40%. Spraying with pesticides is not only expensive and harmful to the environment, but is usually ineffective, as the chemicals cannot reach the pests deep inside the stem. Preventing crop losses from stemborers could increase maize harvests enough to feed an additional 27 million people in the region.

Called the 'push-pull' strategy, ICIPE's approach makes use of the resilience of nature and the built-in checks and balances to operate in man-made environments such as maize fields by manipulating the agro-ecohabitat. The approach relies on a carefully selected combination of companion crops to be planted around and among the maize plants (see photo, facing page).

Dr Zeyaur Khan, the leader of the Habitat Management Programme at ICIPE, says that both domestic and wild grasses, often ploughed under in modern monocropping (maize-only) practice, can help protect the maize by attracting and

trapping the stemborers. The grasses are planted in a border around the maize fields, where invading adult moths become attracted to chemicals emitted by the grasses themselves. Instead of landing on the maize plants, the insects head for what appears to be a tastier meal. These grasses provide the 'pull' in the 'push-pull' strategy. They also serve as a haven for the borers' natural enemies. Good trap crops include the well-known Napier grass (*Pennisetum purpureum*) and Sudan grass (*Sorghum vulgare sudanese*), a type of wild sorghum. Napier grass has a particularly clever way of defending itself against the pest onslaught: once attacked by a borer larva, it secretes a sticky substance that physically traps the pest and effectively limits its damage. The natural enemies lurking among the grasses go into action and dispatch the borers in both maize and grass host plants. (A complementary ICIPE project is introducing natural enemies to boost the allied forces to fight the borers.)

The 'push' in the intercropping scheme is provided by plants that emit chemicals (kairomones) that repel the borers and drive them away from the maize main crop. The best candidates discovered so far for their borer-repelling properties are members of a leguminous genus *Desmodium* spp. *Desmodium* is planted in between the rows of maize. Being a low-growing plant (see photos next page), it does not interfere with maize growth, and furthermore has the advantage of maintaining soil stability and improving soil fertility through its nitrogen-fixing action. *Desmodium* is easy to harvest and serves as a highly nutritious animal feed. Another plant showing very good repellent properties is molasses grass or *Melinis minutiflora*. This is a 'jack-of-all-trades' grass, as it is also a nutritious animal feed and repels ticks to boot!



Stemborers are the worm-like larval forms of certain species of moths, which attack not only cereal crops (maize, sorghum, rice) but also other plants in the grass family such as sugarcane and wild grasses. *Left: Adult moth of the spotted stemborer, Chilo partellus, a major pest of cereal crops in East and southern Africa. Right: The worm-like larval form is the stage that causes the damage as the larvae eat their way through the stem.*

A further bonus is in store for the farmer who uses push-pull for pest control: Not only can she/he harvest 3 crops (maize, desmodium, *Melinis* forage and Napier grass forage), but another widespread maize pest can be controlled: the witchweed, or *Striga hermonthica*. A ground cover of desmodium interplanted among the maize reduces striga growth by a factor of 40.

Mrs Respa Ouso, a farmer in the semi-arid Suba District practising 'push-pull' technology, has observed an increase in her overall maize yields by up to 100 percent by controlling both stemborers and striga weed. Now that she is producing fodder, she has been able to keep grade cows and can thus provide her family with milk. She and her friends are also becoming members of the cash economy by selling desmodium seeds to other farmers. Maize production on 150 farms practising 'push-pull' in Kenya is up by 25-30% and milk production has increased by an average of 50-60% in Suba District among participating farmers, with the benefit-to-cost ratio estimated at 2.25 among farmers using the push-pull approach. (This means that for every Kshs 1,000 invested, a return of Kshs 2,250 will be earned.) The habitat management approach to pest control, started in 1997 with continuing support from the Gatsby Charitable Foundation (UK), is being demonstrated on more than 1,500 farms in ten districts of Kenya including Trans Nzoia in the breadbasket of Kenya and in the less productive semi-arid regions around Lake Victoria. The other districts in Kenya where the technology is being demonstrated are Kisii, Bungoma, Busia, Siaya, Migori, Homa Bay and Rachuonyo. More than 100 farmers are testing the push-pull technology in Uganda.

How does push-pull really work? The underlying chemical ecology of plant defense mechanisms are also being studied by the project. For instance, molasses grass releases volatile chemicals that discourage stemborer adults from laying eggs, thus protecting nearby maize. Molasses grass also attracts natural enemies of stemborers which help in the defense. Current studies are focusing on the identity of chemicals produced by the roots of desmodium that are responsible for suppressing the striga weed. Whatever the strategy, stemborers are now on the defensive when push-pull is at the battlefield.

This work is undertaken in collaboration with

- Kenya Agricultural Research Institute
- Ministry of Agriculture and Rural Development (Kenya)
- IACR-Rothamsted, UK
- National Agricultural Research Organization (Uganda)



Mrs Respa Ouso surveys her maize field with heavy infestation of the parasitic striga weed and stemborer damage.



Using the push-pull management approach, Mrs Ouso stands in her maize field planted with desmodium between the rows of maize to repel the borers, and Napier grass as the trap crop.



In this field, Napier grass has been planted as the trap crop, and desmodium in between the maize plants to repel the borers. If using Napier grass (the Bana variety is best), then 3 rows of Napier need to be planted as a border all around the maize field. Inset: Both Napier and desmodium are highly nutritious forage feeds.

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