AFRICAN ORGANIC SUCCESS STORIES – The ICIPE in Kenya.

NATURAL SUCCESS STORIES – The ICIPE in Kenya

By Florianne Koechlin, June 2000 fkoechlin@mail.datacomm.ch

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Articles, information on ICIPE and biological pest-control: http://www.icipe.org and http://www.blauen-institut.ch

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Biological Pest Control

Together with a group of journalists I spent a week at the Research-Institute ICIPE (International Centre of Insect Physiology and Ecology) in Kenya. I came home all enthusiastic about their projects, about their innovative approaches to tackle some of Africa's key-problems in agriculture. The ICIPE specialised on biological pest-control. Modern science is used to search for cheap and sustainable solutions to control stemborers, tsetse-flies, locust-swarms, ticks, fruitflies, anopheles-flies (vectors of malaria) etc. The collaboration with and capacity-building of farmers is essential.

Stemborers and the push-pull system

We're in West Kenya, in a field station of ICIPE near Lake Victoria. The small maize-field in front of us looks dreadful: the plants are only 1 m high, the leaves yellow and full of holes, and there are almost no cobs at all. Close by, Mrs Ouzo, the farmer of these fields, shows us another maize-field – the plants are over 2 m

high, with darkgreen leaves and healthy cobs. It's the same maize-variety on both fields, planted on exactly the same day. The difference could not be bigger. The first maize-field was destroyed by stemborers and striga (witchweed), the two most important pests of maize and sorghum in all Africa. Stemborers can destroy up to 80% of the crop in no time, the loss of crops due to striga varies from 20 to 80%. If both pests are present at the same time, they can easily destroy the whole crop.

Around the second field, Mrs Ouzo planted 3 rows of napier-grass. "The beauty of this grass is that its odours are attractive to stemborers", says scientist Zeyaur R. Khan. "The grass then produces a gummy substance that traps the pests. Only about 10% of the stemborer-larvae survive In the end". Between the maize-rows, Mrs Ouzo planted the leguminose desmodium, an earth-covering plant whose odour repells stemborers.

The stemborer is attracted to napier-grass (Pennisetum purpureum) at the outside of the field and repelled by desmodium (Desmodium uncinatum) from the inside of the field – this "push-pull"-system was originally developped by ICIPE. Starting point was the knowledge that stemborers must have been indigenous to East Africa long before maize was introduced there (about 100 years ago). Originally, its host must have been different kinds of wild grass, only later on, it specialised on maize, which had no resistance against it – but was all the more nutritious. For 4 years, Khan and his team selected several species of wild grass with strong stemborer-attracting odours and cultivated them in a garden near the local station. Farmers from the surroundings were invited to choose from the different varieties: they mostly preferred Napier- and Sudan-grass, which both look very similar to maize and are good fodder. Varieties of wild grass looking more like "weed" were left aside.

The selection of "repellent-plants" was successful, too: molasses-grass (Melinis minutiflora) reduced the loss of crop from 40% to 4,6%. The analysis showed a complexe mixture of terpinoles, nonatrienes and some more volatile molecules (nature, 14.8.97, p. 631). Also, the leguminose silver-leaf-desmodium is a good

stemborer-repellent. Furthermore, it binds nitrogen and thus enriches the soil. It keeps the soil moist and protects it from erosion. But most of all: desmodium is most effective against Striga – to everybody's surprise. With desmodium, striga is suppressed by a factor of 40 compared to maize monocrop.

Although striga is a very beautiful weed with its pink blossoms, it is a most deadly plant. Striga is a parasite to maize-roots. One single plant produces 20'000 tiny seeds, that disperse easily. In all Africa, problems caused by Striga are increasing. An ICIPE research project (funded by the Rockefeller Foundation) examines the reasons why desmodium suppresses striga.

"Last year, I sold my napiergrass and desmodium as fodder for 6000 shillings (about 100$, FK). With this money, I could afford to pay the school fees for my kids. This year, I am planning to produce Desmodium-seed as well because all of my neighbours want to go for this push-pull-system. Maybe, I can afford a cow then", says Mrs Ouzo. As one of the first farmers, she was chosen for the project because her fields were most heavily infested by stemborers and striga. ICIPE plans to establish the push-pull-system not only in further areas in Kenya, but also in Aethiopia, Uganda and Tansania, in close co-operation with the national programmes.

Stemborers and a small wasp

Stemborers have natural enemies, which can be used successfully as well: 5 different species of stemborers exist in Africa, the most aggressive one is the spotted stemborer (Chilo partellus). It was introduced from India/Pakistan to Africa some 70 years ago. ICIPE scientists went to India to do research in these centers of origin. They found Chilo partellus being a harmless pest kept well under control by several natural enemies. One of them is the little wasp Cotesia Flavipes Cameron: it tracks down the stemborer larvae deep inside the stem and lays its eggs into the pest; these then hatch out and consume the borer from within.

After careful testing, this wasp was released on 3 sites in Kenya. By now, the wasps are well established; they not only go for Chilo partellus, but for 3 other stemborer-varieties, as well. The latest results show that stemborer-infestation could be reduced by 53% in these areas. "Maize only came to East Africa some 100 years ago, and had no resistance against the stemborer. The immigrated stemborer Chilo partellus had no enemies. Any ecological balance that existed between native stemborer and wild grasses was severly disturbed. We try to reintroduce a natural equilibrium into this system", says Bill Overholt.
I wanted to know if Cotesia flavipes could not harm other insects as well. Overholt denied: "The host range of this wasp is limited by its searching behaviour, which restricts hosts to stemborer larvae found tunneling inside the stems of larger grasses. And then only certain stemborers, and only the later larvae instars of these, are suitable for the development of the wasp-parasites. We made careful evaluations, and we did not find one other insect matching all these requirements."
ICIPE is working closely together with national programmes in Kenya, as well as in Uganda, Somalia, Mozambique, Malawi, Ethiopia, Zambia, Zimbabwe and Zanzibar to release the wasp Cotesia in all of these countries.

Stemborers and transgenic Bt-maize from Novartis

A third – and very different – strategy to fight the stemborer consists in introducing genetically engineered Bt-maize. The African stemborer-species are close relatives to the European corn-borer, against which the Bt-maize was constructed. The Swiss company Novartis wants to test and introduce Bt-maize in Kenya: in spring 2000, they started a 5-year program with Bt-maize, at costs of 6,2 million$, in co-operation with the Kenyan Research Institute KARE and the Latin-American CYMMIT.
This project was presented at a meeting in March in Nairobi, "which turned into one single tribunal against Hans Herren (the director of the ICIPE). They accused him of being an ennemy of Africa, and of assuming Africans were incapable of

handling biotechnology" (The Tages-Anzeiger, 21.6.00). Klaus Leisinger, director of the Novartis foundation for sustainable Development, accused Herren of having gone to the Swiss development Agency to get them off GMOs. This is not true.

Hans Herren is critical, but he is not a strict ennemy of genetic engineering, and he told an audience of Swiss governement officials about his sceptisism:"Possibly, transgenic maize will be part of the solution in the far future. But what about the other problems? The interesting thing about the push-pull-system is: It already exists and the farmers use it. It was developped together with the farmers. With the push-pull-method, we have an integrated solution for the problems of the stemborer and striga. We have protein-rich fodder, Nitrogen fertilizer and a good protection against soil-erosion. All this within one field. It's a system that's enhancing justice and a sustainable agriculture."

ICIPE – Integrated research on tropical insects

350 people work at the ICIPE, mostly Africans. The main issue of ICIPE are Africa's most damaging pests, at costs of millions of lives (humans and animals) each year and 30% crop-losses on average: the Anopheles-mosquito (vector for malaria), the tsetse-fly (vector for human sleeping sickness and several fatal animal-diseases, such as nagana in cattle and sura in camels), the tick, the locust, the fruit-fly (eg destroying each year 20-80% of the mango-crop) – and the stemborer. Useful insects are studied as well: ICIPE initiated a local silk-production with African silkworms and local honey-production. Another main issue at the ICIPE is capacity building (from farmers to PhDs).

Interdisciplinary teams of scientists are doing pioneering work in the area of biological pest-control. They are working on insect behaviour and population ecology, they study the ways of communication of insects, they analyze the odours of insects and plants, and search for the molecular conditions of vector-mechanisms, they do molecular insect-taxonomie and search for ways to protect

– and use – the vast biodiversity. All the time, the goal is to use modern science to develop simple and efficient methods that farmers can afford.

"We are looking for solutions in nature, we want to understand the system and identify the weak links, where we can intervene. How can we favour natural enemies of the pests, what odours will attract or repell them, how can we reintroduce a better equilibrium?", says director Hans Herren. François Omlin, a scientist who started to work at the ICIPE recently, confirms: "I do not know of any other research-institute worldwide, working in this area in a comparable interdisciplinary way – in this place, molecularbiologists are working together with behavioural scientists and entomologists. And furthermore, all of us are in close contact with the farmers."

"Biological pest-control is not as sexy..."

Hans Herren, director of the ICIPE, won the World food prize in 1995 because he and his team could get control over the cassava mealy bug, that was endangering the staplecrop cassava in large areas of Africa (from Senegal to Moçambique) and threatening some 300 million people. They got control over the bug with the help of a small wasp – without chemistry, and without any extra costs for the farmers. Thoughtfully, Hans Herren says: "Today, I probably would not get the money for such a big programme. Today, all funds go into biotechnology and genetic engineering. The genetic people would try to construct a cassava that is resistant against the mealy-bug. Biological pest-control, as we do it here at the ICIPE, is not as spectacular, not as sexy. I see a big problem here."

Scents against locust swarms

In the world of insects, scents play a major role not only as a means of orientation (attracting and repelling 'road signs'). For insects, odours are the most important way of communication.

E.g. desert-locusts: since 10 years , Ahmed Hassanali and his team at the ICIPE do research on the desert-locusts, more strictly speaking: on their communication. The central question was: how and why do harmless single locusts suddenly turn into most dangerous swarm-locusts? What are the mechanisms of gregarisation and the development of locust outbreaks? In general, desert locusts are solitary insects.

Over several generations, at particular times, they build small swarms. Sometimes, they form bigger swarms, which can, all of a sudden, turn into one huge swarm of as much as 40 billion insects. In Madagaskar, in the years 1997/98, a swarm like this destroyed the vegetation in an area of 1,4 million ha. For ICIPE-scientists, odours were the key for the understanding of swarm-formation. Hassanili and his group isolated and identified 5 different sets of chemical messages. These 'morse-codes' regulate behaviour and life-style of desert-locusts. Some odours regulate the behaviour in swarms of young and of adult insects, others determine their behaviour of cohesion, the synchronous maturation, and the communal oviposition. Another volatile chemical attracts the females to their common egg-laying place.

At this point, the scientists intend to intervene: they exposed young hopper-gangs to a very low concentration of odours from adult locusts. The results were most fascinating: the hoppers became hyperactive; they lost their orientation and began to cannibalise. The hopper-swarm – shortly before a huge mega-organism – fragmented into separate parts. The swarm insects turned into solitary insects again, becoming an easy prey for birds. Electrophysiological studies at the University of Lund (Sweden) showed that the odours of adult insects blocked the signal-transfer between the hoppers, resulting in a total loss of communication between the individuals. "As if you cut the telephone line", says Ahmed Hassanili. The moment communication breaks down, nothing happens anymore. The swarm is held together only by intense and constant communication between the insects. The ICIPE now produces the volatile chemical in larger quantities and hopes to test this method during the next out-break. "This would be a very simple

und extremely environmental-friendly method", says Hassanili. "During the last big plague 250 million$ were used exculsively for insecticides, 12$ pro ha. We estimate, that with the odour-method costs will be at one dollar pro ha at the utmost. And all this, without spraying toxic insecticides and without longtime accumulation-problems."

Three other ICIPE projects, very briefly :

Tsetse-flies, the vectors for various fatal cattle-diseases, cause yearly losses of 20 to 40% of all cattle in Africa. Buffalo- and cow-urine turned out to be strongly attractive to the flies. With these odour baits the flies can be lured into simple traps. ICIPE scientists around scientist Rajinder Saini also developped a potent repellent now being tested on cattle. Other repellents are being isolated from body-scents of animals that are never attracted by tsetse-flies (like the water buck).

Other tsetse-programmes: R&D of larvae-pheromones to attract 'pregnant' female-flies; behaviour-studies of the tsetse fly, identification of tsetse-fly-hosts with ELISA-tests on blood-meals of the flies; investigating traditional knowledge of tsetse-repellent plants.

Neem-programmes: Development of natural pest control agents from the neem tree (see also mail-out 76): Neem is being used locally to control root-knot nematodes and fruit borers on tomatoes, aphids and Diamond black moth on cabbage, it is being tested against leafminers, banana weevils and ticks, for postharvest grain protection etc. We visited a neem-nursery at the ICIPE: They grow 10'000 neem-seedlings yearly and sell them cheaply to farmers. The responsible scientist is Ramesh Saxena, lovingly called the "Neem-guru", and even his screen saver shows a big floating NEEM- signature. ICIPE also developped simple on-farm technologies for the preparation of neem formulations, and initiated a series of workshops on the use and raising of neem, for farmers, womens groups and NGOs

Silkmoth conservation and utilisation: Breeding of a new domestic silkmoth hybrid which produces a high quality silk, growing of mulberry cultivars. The reeling of cocoons is done in a simple reeling machine which can be operated manually or by eletricity.This sericulture (silkworm rearing) already today enhances the productivity and economic returns of smallscale farmers and women's groups.

A survey of indigenous wild silkmoths in Kenya and Uganda has identified 2 species, Argema mimosae and Gonometa spp., that produce silk fibres of high quality; another 56 native species have been recorded in East Africa, indicating a high diversity and potential for wild silk production in this area.

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