well-known failures, a third of biological control programmes … were judged successes". *Scotland on Sunday* (Jenny Fyall, 21 March) was more critical, and perhaps more typical: "In the past most introductions of alien species for pest control in other parts of the world have ended disastrously", citing thistle weevils in the USA, as well as... the cane toad.

The *Guardian* (Jowit, 9 March), was rare in acknowledging that classical biological control is not entirely new in the UK, citing the introduction of *Rhizophagus grandis* against spruce bark beetle in the 1980s. More typically, the *Daily Telegraph* (Leapman, 9 March) felt that "Biological control … is at its most effective and manageable in confined spaces", citing the use of predatory mites in greenhouses, and nematodes against slugs and snails "over a limited area of the vegetable garden" but that "Letting flocks of tiny insects loose to blow in the wind seems altogether more reckless".

Generally, the treatment of the news of *A. itadori*'s release in the mainstream media was fair. In contrast, bloggers were less balanced in their expressed views; although some were well informed, others were not (but that is another story). Over the years, at least partly through CABI's public engagement efforts, there have been repeated reports in the UK press about the build-up to this release, so that many environmental correspondents had been exposed to the concept already. This was probably an important precursor to receiving fair coverage.

Cassava Mealybug Has Reached Asia

In May 2009, the Department of Agriculture at Chatuchak, Bangkok, Thailand contacted the International Institute of Tropical Agriculture (IITA) in Benin for help in the biological control of the cassava mealybug, *Phenacoccus manihoti*, which had recently invaded Thailand and probably also Laos and Cambodia. By then, this mealybug had already spread across 160,000 ha in the eastern and northeastern provinces of Thailand, where cassava is an important export crop, mainly for starch production and cattle feed. Following pressure from the farmers and the Thai Tapioca Development Institute, including four other private sector associations (the Thai Tapioca Trade Association, the Thai Tapioca Processors Association, the Northeast Tapioca Processing Plants Association, and the Thai Tapioca Starch Producers Association), the government authorities became concerned about the high economic impact of this new pest. In fact, the forecast for cassava production was reduced to only 22.21 million tonnes for the 2009–10 harvest season, down from an earlier forecast of 27.76 million tonnes. This predicted loss was attributed to the devastation caused by cassava mealybug.

This same mealybug had reached Africa in the 1970s and caused widespread devastation and even famine when it destroyed cassava, which on that continent is an important food and locally traded subsistence crop. At the time, an IITA-led group of institutions, including CABI, CIAT (International Center for Tropical Agriculture), EMBRAPA (Brazilian Agricultural Research Corporation), the Agricultural Ministry of Paraguay, and the numerous agricultural ministries of the 20 or so concerned African countries under the umbrella of the Phytosanitary Council of the Organization of African Unity, had started a campaign to find, import, rear and distribute adapted natural enemies from South America, the purported home of this foreign invader. By 1981, the encyrtid parasitoid *Anagyrus lopezi* (then *Apoanagyrus* or *Epidinocarsis*) had been located in Paraguay, later in Brazil, shipped through quarantine, mass-reared at IITA-Nigeria and distributed. What followed was one of the greatest recent successes in classical biological control. By 1995, when the whole continent was invaded by the cassava mealybug, *A. lopezi* had been released at about 150 sites, where it established and from where it spread throughout all cassava-growing countries of sub-Saharan Africa[1]. In each country, within 2–4 years of its establishment, mealybug populations fell by ten times or more to non-economic levels, producing economic benefits of billions of dollars (depending on which scenario of benefit calculation was adopted)[2]. Other natural enemies were also released; some established, but none became important. Interestingly, *A. lopezi*, an uncommon parasitoid found in South America in a rather limited area of the Rio de la Plata basin, had been able to establish in Africa in all ecological zones, from the dry Sahel through the Congo rainforest to the East African highlands. The only places where control was not satisfactory and where *A. lopezi* was not considered effective were unmulched fields on very sandy soils. In these places, only better soil management was able to improve the situation.

In the beginning, the rate of spread of mealybug in Africa was around 150 km per year, but once *A. lopezi* had reached the front, further spread of the mealybug slowed considerably. Thanks to good quarantine services, Madagascar and neighbouring islands of the Indian Ocean remained free of this pest and onward spread seem to have been halted – that was, until the discovery of cassava mealybug in Asia last year. By 2009, the pest had already spread widely in Thailand, so that it must be assumed that the actual introduction had occurred some time in 2008 or perhaps earlier. The new invader was not immediately recognized because another closely related mealybug species common on cassava in Thailand, presumably *Phenacoccus madeirensis,* confused the situation. Once the invader had been identified by a taxonomic authority in the California Department of Food and Agriculture, USA (Dr Gillian Watson), the path for classical biological control was cleared. *Anagyrus lopezi* was imported from IITA-Benin into Thailand in September 2009 and reared under quarantine conditions at the Department of Agriculture, Bangkok, with a view to releasing the insect once release permits were issued. This happened in November 2009. Since then, about 2000 pairs of *A. lopezi* have been released on 100 ha of cassava at the Rayong Field Crop Center. In January 2010, more than 6000 adults were collected and re-released nearby. Currently, three rearing units are being constructed in the outbreak areas located in the east, northeast and central plain of the country.

Conditions in Thailand are rather unlike those in Africa. Cassava varieties and the economics of cassava production are different, and herbicides and insecticides are largely available to farmers and often used indiscriminately. At the species level, the local food webs also differ from those in Africa. A monitoring programme was thus set up.

Though mite pests were also discovered on cassava, these proved to be local *Mononychellus* (in the northern part of the country) and other species. However, the feared cassava green mite *Mononychellus tanajoa* from South America, which led to an equally important biological control programme across Africa, does not seem to have reached Asia yet.

It is hoped that by extending the collaboration that was so successful in Africa to Asia, the exotic mealybug will be controlled within a much shorter time span and at much reduced costs.

Recent press articles have reported mealybug damage to cassava in Banteay Meanchey Province in western Cambodia, ascribing this to the spread of *P. manihoti* across the Thai border. The cassava sector would like to see a swift response to what may rapidly become a serious threat to their industry. However, the species involved has not been yet identified and it is important that this is done quickly. As in the case of Thailand, before biocontrol agent introductions are set in motion, a preliminary risk assessment should be made and basic biological data collected about the food web of insects already associated with the mealybugs. This would inform a strategy decision, which should be made by the responsible authority in Cambodia, and allow post-release impact of introduced agents to be assessed.

[1]Neuenschwander, P. (2001) Biological control of the cassava mealybug in Africa: a review. *Biological Control* 21, 214–229.

[2]Neuenschwander, P. (2004) Harnessing nature in Africa. *Nature* 432, 801–802.

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Fighting Back at the Erythrina Gall-forming Wasp with a Natural Enemy

The *Erythrina* gall wasp (EGW), *Quadrastichus erythrinae*, was first described by Kim and co-authors in 2004 (*Journal of Hymenoptera Research* 13, 243–249) from specimens collected in Mauritius, Reunion, and Singapore. EGW was later found in Taiwan, then Florida and many other countries in Asia and the Pacific. A eulophid gall-former, it was inadvertently introduced into Hawaii in April 2005. Subsequently, it spread throughout the state causing onslaught and near decimation of native and introduced *Erythrina* trees. A gravid female deposits its eggs into the young leaves, petioles, and stems of the host trees. The larvae develop within the plant tissues thus resulting in the formation of galls, curling of leaves and swelling of shoots. Severe wasp infestation eventually leads to the death of affected trees.

At the onset, Hawaii government agencies and other pest practitioners employed various control methods, such as tree trimming, drenching, spraying and chemical injection, to control the wasp pest but to no avail. Consequently, the Plant Pest Control Branch of the Hawaii Department of Agriculture (HDOA) opted for classical biological control to mitigate the impact and further decimation of the *Erythrina* trees. In December 2005, a natural enemy of the wasp pest, *Eurytoma erythrinae*, was collected in Tanzania in East Africa. It was shipped back to the HDOA Insect Containment Facility where it was evaluated further to determine if it posed any potential threat to non-target organisms and native fauna in Hawaii. Subsequently, it was approved for release in Hawaii by the federal and state regulatory agencies.

An ectoparasitoid, *E. erythrinae* inserts its eggs into the plant tissue where a newly-hatched larva bores through to access the developing immature of the host pest inside the larval chamber. The parasitoid feeds and continues to prey on one or more hosts as it grows and matures. More often than not, the parasitoid larva will tunnel from gall to gall in order to satiate its need for additional food. This behaviour makes *E. erythrinae* a desirable biocontrol agent because its feeding causes the demise of multiple pest individuals.

Initial releases of the parasitoid throughout the state were commenced in November 2008. From all indications, the parasitoid is an effective biocontrol agent because more than a year after it was liberated, the unprecedented spread and persistent infestation by the gall-forming wasp has been considerably slowed down and largely thwarted. Sustained monitoring of wasp infestation on the *Erythrina* trees combined with dissection of gall deformities showed that the parasitoid is now widespread throughout the island chain, that trees have continued to bounce back with full, clean canopy, and that the parasitoid has caused as high as 90% mortality of the wasp pest.

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Biocontrol Agents Fly Through X-Ray Scans

In the movie and comic book The Incredible Hulk, Dr Bruce Banner, is exposed to a high level of gamma rays during an experiment gone wrong, and transforms into a giant green-skinned hulk whenever his pulse rate gets too high. In real life, irradiation –