Low-cost natural spray kills African armyworm

RIU

Validated RNRRS Output.

Poor farmers now have a new, low-cost spray to control African armyworm. This devastating pest migrates from Tanzania and Kenya to eastern and southern Africa. Farmers can lose between a quarter to nearly three-quarters of their crops and pastures in armyworm outbreaks. As well as being environmentally friendly, the new spray replaces expensive chemical insecticides. It's made from armyworms that die when they feed on low-grade pastures sprayed with a virus. Because the dead armyworms are full of the virus, they can then be used to make more spray to kill more armyworms. This can be done locally rather than in far-off factories. Proven in Tanzania, the spray kills armyworm just as effectively as conventional insecticides and is already used in the armyworm control programme there.

Project Ref: **CPP43:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Protection Programme**

Document Contents:

Description

CPP43

Research into Use
NR International
Park House
Bradbourne Lane
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Geographical regions included:

Tanzania,

Target Audiences for this content:

Crop farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.

Novel biological control for African armyworm (Spodoptera exempta) using low cost endemic armyworm nucleopolyhedrovirus (NPV).

In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

NPV- Novel biological control for African armyworm

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Crop Protection Programme, USAID .Emergency management programme

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R 8408 Novel controls for armyworm in East Africa adopted, demonstrated and disseminated to national and regional organisations
R 7954 Novel technologies for control of African armyworm on smallholder cereals in Africa
R 6746 Entomopathogenic baculoviruses for control of the African armyworm in Tanzania
USAID Project 58 – 4001- 3F037 Application of Spodoptera exempta Nucleopolyhrovirus (Spex NPV) for area wide strategic armyworm control in Tanzania.

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4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? ***(max. 400 words)****. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

The output was the development of a new low cost non-chemical environmentally friendly technology for **African armyworm contro**l using the endemic African **Baculovirus** the **Spodoptera exempta nucleopolyhedrovirus** (SpexNPV) .

African armyworm is a major **migratory pest** originating annually in the primary outbreak areas of **Tanzania** and **Kenya** that can subsequently spread over large areas of **Eastern and Southern Africa** devastating cereal crops and degrading rangeland. In Tanzania alone, the area infested over the last 10 years has varied but is most severe after droughts increasing its impact on the poor. The latest outbreak in 2006 was estimated as damaging more than 500,000 ha of crops. In a recent socioeconomic survey in Tanzania (Njuki et al., 2003), farmers estimated average losses in poor growing seasons to be 70% though in good seasons overall average yield loss was estimated at 23%. Existing control techniques depend upon the use of chemical insecticides but fails in protecting 70% of poor smallholders as chemicals are too expensive for poor.

The SpexNPV was evaluated in series of field trials and was shown to be as effective at killing armyworm as conventional insecticides. A crucial potential advantage of SpexNPV is that it does not need to be manufactured in expensive chemical plants or biotechnology facility but can be produced from armyworm material collected from natural armyworm outbreaks. If outbreaks on low value pastureland are sprayed with SpexNPV then later the dying insects, by now full of replicated virus, can be collected and processed to produce more NPV. The project adapted a simple systems for collecting and processing NPV This local production could provide a cheap safe system of control that can be produced in Tanzania SpexNPV could be produced by this method at an estimated cost of a maximum of 3.0 US$ per ha (chemical insecticides cost minimum of 10 US$ ha. Another output was that local Neem was shown to be a useful local solution for many poor people in the absence of access to better options..

Another key project output was to encourage the adoption of a policy of promoting sustainable non- chemical control by African countries. Tanzania has now adopted this approach and the regional organisation desert Locust Control Organisation East Africa (DLCO-EA) is keen to adopt the output.

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	Technology	Service	Process or Methodology	Policy	Other Please specify
X	X			X	

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

The output is focussed on controlling armyworms on a range of cereal crops currently grown in eastern Africa that are damaged by armyworm outbreaks including maize, sorghum, wheat, barley, and rice. Armyworm also attack and damage livestock pasture both by direct consumption and by stimulating cyanogenic grasses to build up cyanide levels that make these usually nutrious grasses toxic to livestock. The NPV technology could be applied to any armyworm outbreaks on any commodity attacked.

The low cost production and formulation system developed as an output by the project could be applied to producing NPVs for other appropriate major pests of developing countries on vegetables, cotton or fruit crops, or forest pests e.g. Helicoverpa species, Spodoptera species

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	High potential	Hillsides	Forest-Agriculture	Peri-urban	Land water	Tropical moist forest	Cross-cutting
X							

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	Irrigated	Wetland rice based	Smallholder rainfed highland	Smallholder rainfed dry/cold	Dualistic	Coastal artisanal fishing
X	X		X			

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

The effectiveness of an armyworm control programme using SpexNPV would depend crucially on the availability of good forecasting of outbreaks both a national and local level if spray operations and the necessary resources are to be brought to bear judiciously and in time.

A novel armyworm control system could be most clearly clustered with improved national and the community based forecasting systems developed by projects R8407, R7966,R6762 to produce an integrated forecasting and control system for armyworm in East Africa. An effective forecasting of armyworm outbreaks is essential if NPV control of armyworm is to be really effective. The corollary is that forecasting outbreaks has little impact if poor farmers and national control systems (which exist in Tanzania and Kenya) lack sufficient access to a safe and affordable armyworm control technology.like NPV to prevent crop losses.

Alternatively it could be clustered into an African 'migrant pest' cluster that might include community based forecasting (R8407/R7966/R6762) and Quelea (R8426, R7967, R6823, R8314) for a Cluster with a specific East Africa focus. Alternatively in addition with brown locust (R7790) and ICOSAMP (R8315, R7890) for a Southern and East African Migrant cluster. While grouping all these migrant pest outputs would appear logical it may represent too large, and geographically diverse a grouping to be the most appropriate platform for future activities.

The adoption of two distinct linked but separate regional clusters for East Africa and Southern Africa building onto the existing regional migrant control networks DLCO-EA for Eastern and ICOSAMP for Southern Africa may be a more practical solution to clustering future migrant pest outputs in line with the developing regional strategies for African agricultural research based upon regional bodies such as ASARECA and SADAC.

Validation

B. Validation of the research output(s)

*10**. How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

So far trial validation has been undertaken by the Tanzanian national body charged with the implementation of national armyworm control strategy (Pest Control services of Ministry of Agriculture). These are the end users for the national armyworm control strategy in Tanzania. African regional DLCO-EA, international migrant pest organisations

Internationally the work has been validated by having a scientific paper on the field trial results of the armyworm project accepted by the international peer reviewed journal Crop Protection

*11. **Where and when** have the output(s) been validated?*

Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which

production system and farming system, using the options provided in questions 7 and 8 respectively, above ***(max 300 words)****.*

In Tanzania during the period 2001- 2004 the organisations responsible for national armyworm control PCS and TPRI collaborated led validation trials of the new technology of using SpexNPV for armyworm control in Kilosa district (central Tanzania,Arusha and Arumeru districts in northern Tanzania. Neem validation was carried out in tandem with NPV work as part of the same trials programme. It has been evaluated using both small scale and large scale ground application but has not yet been validated for area wide aerial application which would be the method of choice for national control.

The low cost NPV production was developed during 2003-2005 once the use of NPV had been shown to be promising as an alternative to chemical insecticides. The NPV production system is itself a simple adaptation of one developed by EMBRAPA in Brazil for control of a major Soybean pest. This has been developed since the late 1980s and was validated and scaled up by EMBRAPA and six of commercial partners in Brazil. The system has been running for over ten years and now produces NPV for treating 4 million hectares annually by smallholder farmers in Brazil. Since 2003 this is the most widely used biopesticide for velvet bean caterpillar on soybean. Thus while the production system has not itself been validated for SpexNPV it has been validated with another very similar insect virus over a long period and on a large scale.

Current Situation

C. Current situation

12. ***How and by whom*** *are the outputs currently being used? Please give a brief description* ***(max. 250 words****).*

SpexNPV is used on a pilot scale as simple substitute for chemical insecticide in the armyworm control programme of Tanzania. It has been found that it can be applied by both ground and aerial spray.

Ministry of Agriculture and food security is the currently only user of the NPV technology on a pilot scale at present. DLCO the regional armyworm control organisation has said it would be very keen to take up and promote the technology regionally as part of its future work. There is also a strong support from USAID Regional Economic Development Services office for East and Southern Africa (USAID – REDSO/ESA) to promote the technology as part of integrated approach to control African Armyworm in the region. FAO migratory pest experts and USAID Emergency management team have visited the project to familiarise themselves with the technology and approaches. Following the visit of Dr Clive Elliot, FAO Rome migratory expert in Tanzania March, 2006, at the start of massive armyworm outbreak, two national FAO offices in Mozambique and Malawi have requested proposals to scale out SpexNPV technology to those countries. USAID Tanzania has requested (Sept 2006) the project team to submit proposals to scale up SpexNPV alongside community based forecasting.

The use of neem leaf as a “home made” armyworm insecticide is in use by smallholders in the 5 pilot districts in Tanzania where CBF was promoted though data on uptake and effectiveness is not yet available. Neem pesticide under the brand name Neemrin had been registered in Tanzania to control various caterpillars including

armyworms, the production is still at pilot commercial stage and more effort is required to increase the production to meet the demand.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

SpexNPV in Tanzania in the Arusha and Arumeru districts.

*14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading **(max 250 words).***

So far only used on pilot scale trials by a single user PCS ministry of Agriculture in trials.

*15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? **(max 350 words).***

There are a number of key organisations that assisted promotion.

The Tanzanian Ministry of Agriculture national armyworm programme as implemented by PCS Arusha was a crucial institutional element in driving forward and adopting as national policy the development of alternatrives to chemical pesticides. National Plant Protection Advisory Committee (NPPAC) assisted by investigating sustainable alternative control methods for armyworm. After evaluating the SpexNPV project data and attending demonstrations of SpexNPV the committee became a firm advocate for adopting the technology. The severe armyworm outbreak in 2006 that attacked 500,000 ha in Tanzania and against which conventional pesticide control failed due to lack of availability to farmers was important in raising awareness of the issues in Tanzania and among donors and FAO. Despite FAO raising an extra US$1.2 million from donors for buying additional pesticide for Tanzania chemical control failed to prevent major losses with at least 63,000 ha of cereals being totally destroyed exacerbating the food insecurity generated by the previous drought.

In particular the 2006 outbreak has stimulated Government of Tanzania, USAID and FAO to a policy of investing in developing alternatives to imported chemical pesticides and led to the recent approaches by USAID and FAO country offices in Malawi and Mozambique to scale up work in Tanzania and start projects on SpexNPV in both Malawi and Mozambique as part of the ongoing Africa Stockpile programme (ASP).

The Tanzania ASP project has identified non-chemical control methods as a component in effective prevention of future accumulation of obsolete pesticides. This is appropriate as most of the existing obsolete stock was originally imported for armyworm and locust control.

USAID Tanzania country programme and its ELGA programme for migratory pests became interested in the research in 2001 and thereafter supported in country activities.

The Desert Locust Control Organisation East Africa (DLCO-EA) is the regional body charged with co-ordinating regional armyworm control. To date it has played no direct role in promotion or adoption in Tanzania but it has

been briefed on the work through visit to DLCO HQ in Ethiopia. Following this visit the DLCO-EA director, Mr Peter Odio has requested the project team come out with the regional project proposals on NPV and CBF that DLCO can include in its ongoing programme..

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

The replacement of chemical insecticide based armyworm control by the use a natural biological insecticide especially when treating primary outbreaks in national parks and conservation areas (essential to halt progression to cropped areas) is a major environmental benefit reducing environmental contamination.

The policy of adopting SpexNPV for armyworm control is a step forward in reducing the current problem of toxic pesticide disposal being addressed by the Africa Pesticide Stockpiles programme being financed by World Bank and Government of Tanzania. This policy of replacing chemical pesticides by alternatives such as SpexNPV has been explicitly endorsed by the Tanzanian Ministry of Agriculture. Much of the stocks of toxic pesticides (currently 1,200 MT in Tanzania alone and 120,000 tons in Africa) was originally acquired for migratory pest control of pests such as armyworm and locusts. Such chemical pesticides need expensive (US$ 8 million for Tanzania) safe disposal not available in Africa. SpexNPV is harmless and can be disposed on locally by landfill or composting.

Agencies such as FAO, National AID agencies such as DANIDA and USAID and sub regional African agencies DLCO are keen to see effective non chemical options for migratory pest control and have supported uptake and promotion of biological pest control agents such as SpexNPV as exampled by their support for the fungal locust biological pesticide “Green Muscle” developed in the 1990’s.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

No, the armyworm is the only species susceptible to SpexNPV so its use will have no impact on other species or the environment.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

Yes, armyworm outbreaks are frequently most damaging in drought years when annual rains are short. In these years the main coping strategy of poor people with no access to control technology replanting crops is not viable.

Armyworm outbreaks can confound with drought to reduce even further the already low production of food grains characteristic of drought years. This especially impacts on family grain plots that are a crucial element family food supply in for poor households semi-arid and non irrigated rural areas.