

Maruca-Resistant Cowpea FREQUENTLY ASKED QUESTIONS



TECHNOLOGY

Why do we need *Maruca*-resistant cowpea?

Farmers in west Africa have identified *Maruca* insects as major problems in cowpea production. The damage caused by *Maruca* to cowpea plants reduces the size and quality of the cowpea harvest. Conventional insecticides can be used to control this pest, but they are expensive, their availability to farmers is limited, and due to inadequate training in their use, often lead to unintended human safety impacts. The deployment of a transgenic cowpea product that is capable of protecting itself from attack by *Maruca* will make it easier and cheaper for farmers to produce cowpeas in areas where this pest is a problem.



Which genes have been incorporated into the *Maruca*-resistant cowpea?

The *Maruca*-resistant cowpea contains the *cry1Ab* (*Bt*) and *nptII* genes. The *Bt* gene was derived from the soil bacterium *Bacillus thuringiensis* subsp. *kurstaki*. The *Bt* protein produced in modified cowpea plants has been shown to be identical to the naturally occurring protein, and equivalent to the protein used as a biopesticide by the organic food industry.

The *nptII* gene produces the enzyme neomycin phosphotransferase II, which is used as a plant selectable marker for researchers to identify plants into which the *Bt* gene has been incorporated. The *nptII* gene was derived from the bacterium *Escherichia coli*.

What is *Maruca* pod borer?

The *Maruca* pod borer is an insect pest that preys upon cowpea plants in many African countries. The *Maruca* moths lay eggs on cowpea plants and the emerging caterpillars feed on the plants. This damage affects the quantity of the leaves, flowers and quantity and quality of seeds leading to severe yield loss. Pesticides to control *Maruca* are expensive and are not always available. This results in some farmers using unapproved chemicals to protect cowpea crops, and other farmers having to tolerate the damage because they do not have any effective way to control *Maruca*.

What is *Bt*?

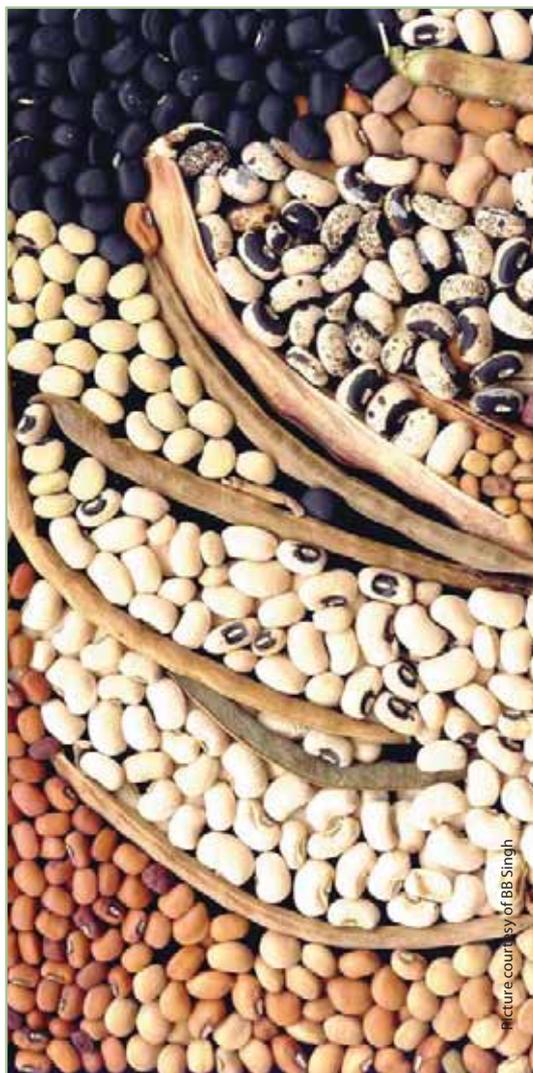
Bt is an abbreviation for *Bacillus thuringiensis*, a soil bacterium that is common around the world. These bacteria produce specialised proteins, called *Bt* proteins, that selectively kill certain types of insects without affecting other living organisms. As such, *Bt* bacteria and *Bt* proteins have been used for years as biological controls for certain insect pests in farming, especially in the organic food industry. Modern biotechnology has produced *Bt* crops which are modified to produce specific *Bt* proteins in the plant cells to protect against specific pests. These crops do not need conventional pesticide sprays to destroy the pests that are controlled by the specific *Bt* protein. Existing, approved *Bt* crops have significantly improved the cost effectiveness and sustainability of crop production in North and South America, Europe, Africa, the Middle East, Asia and Australia.

Where does the *Bt* gene come from?

The *Bt* gene comes from a soil bacterium called *Bacillus thuringiensis*. The *Bt* gene used in *Maruca*-resistant cowpeas (*cry1Ab*) is the same gene used in several *Bt* maize events that have been approved for use in many countries, including Argentina, Australia, Canada, China, Brazil, the EU, Japan, Korea, Mexico, Netherlands, Philippines, South Africa, Switzerland, Taiwan, the UK, the US and Uruguay. The gene was identified and developed by Monsanto and is used successfully in several commercial crops.



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These *Maruca*-resistant cowpeas are now ready for testing in field trials in Africa and approval for these trials has been requested in three countries – Nigeria, Burkina Faso and Ghana.

Who is developing the *Maruca*-resistant cowpea seed?

Maruca-resistant cowpeas are being developed by an international public-private partnership, managed and coordinated by the African Agricultural Technology Foundation (AATF). The varieties to be modified with the *Bt* gene have been identified as farmer preferred varieties and come from the national research centres in participating countries. The *Bt* and *nptII* genes were donated to AATF by a private company (Monsanto) on a humanitarian basis under a royalty free license. These genes were transferred into cowpeas by scientists at an Australian public research centre. The field testing and breeding with *Maruca*-resistant cowpeas will be carried out at African agricultural research centres in participating countries.

What institutions and networks are working on the project?

The development of *Maruca*-resistant cowpeas was initiated by an international research consortium under the Network for the Genetic Improvement of Cowpea for Africa (NGICA) project at Purdue University. The NGICA network uses a holistic approach to cowpea development that includes NARS, academic, public and private sector participants. AATF coordinates and manages the project and is also responsible for the intellectual property and licensing components of the donated insect-resistant technology. Partners include African scientists at universities and public research organisations, American universities and public sector research organisations, an Australian public sector research organisation, industry, the International Program for Biosafety Systems and international agricultural research institutes in Africa. Partners in the field trial testing phase include research organisations, NGOs and national scientists in participating countries in Africa: Burkina Faso, Ghana and Nigeria. All of these participants share one goal and that is to provide African farmers with safe, high quality cowpea seed.

What is *nptII* and where does it come from?

The *nptII* gene was derived from the bacterium *Escherichia coli*, strain K12. This gene produces the protein *nptII*, which is an enzyme called neomycin phosphotransferase II. The presence of this protein is used as a selectable marker for researchers in a laboratory to identify plants into which the *Bt* gene has been incorporated.

What is the current state of research on *Maruca*-resistant cowpeas?

Several *Maruca*-resistant cowpea events have been developed in the laboratory and tested in greenhouse trials. Initial field trials in Puerto Rico indicate that some of the transformed cowpea lines are able to resist *Maruca* attack.

Who is paying for the *Maruca*-resistant cowpea research?

Funding support to the AATF for development of the *Maruca*-resistant cowpeas has come from various sources. The Rockefeller Foundation and United States Agency for International Development have given direct project funding while the UK Department for International Development has provided funds to cover general operations. The project has also benefitted from pro-bono services by international professionals including a patent lawyer. Many NGICA scientists from around the world also donate their time, experience, energy and expertise to this project. Independently, they also raise funds in support of the project.

Has *Maruca*-resistant cowpea been planted anywhere else?

Maruca-resistant cowpeas were planted in field trails in Puerto Rico in 2008 and are being planted at this location again in 2009. These trials are being run to test whether the *Bt* gene is effective against *Maruca* and to provide seed for further field trials.



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How soon can we buy and plant *Maruca*-resistant cowpea seeds in our country?

The developers expect to have the first *Maruca*-resistant cowpea seed available for farmers in 2017. This date will depend on approvals from regulatory agencies; the identification of effective and stable *Maruca*-resistant lines; and efficient transfer of the resistance to traditional varieties through conventional breeding. The *Maruca*-resistant cowpea will need biosafety approval before it can be grown in any country.

Is the technology going to work in local farming systems?

The laboratory and field trial evidence suggests that the technology will work in African farming systems. However, the effectiveness and suitability of the *Maruca*-resistant cowpeas will be tested in field trials in African countries before the seeds are approved for general use.

Will the project strengthen capacity of local scientists, technicians and extension officers?

Yes, the *Maruca*-resistant cowpea project is designed to strengthen the capacity of local scientists, technicians, extension officers and farming NGOs with respect to the new technology, how it is used and how it is tested for efficacy and safety. The project is supported by a holistic consortium of international scientists including national scientists from each of the participating countries where this technology will be used. These local scientists are a key component of the project.

Are there any other GM crops available, apart from *Maruca*-resistant cowpea?

By March 2009, 64 genetically modified (GM) events in 22 plant species had been approved for use in one or more countries. Not all these varieties are suited to African climates, but South Africa, Burkina Faso and Egypt have approved some GM crops for local production.

AGRONOMY

How will farmers get access to *Maruca*-resistant cowpea seed?

The seed will be produced and distributed to farmers using existing and new seed distribution channels. For example, efforts are being made to establish more sustainable seed supply sources in west Africa. These will help ensure that good quality *Maruca*-resistant cowpea seed is available when farmers need it.

Will *Maruca*-resistant cowpeas be planted the same way as traditional cowpeas and do they need more inputs?

Maruca-resistant cowpeas will be planted in the same way as traditional cowpeas. As with any other crop, farmers will be encouraged to follow the best agricultural management practices to maintain high yields by controlling weeds and adding inputs such as fertiliser and water. Planting guidelines to ensure insect resistance management will be provided.

Will *Maruca*-resistant cowpea be easier or harder to plant than conventional seed?

Maruca-resistant cowpea seed will be planted the same way as traditional seed.

Will the *Maruca*-resistant gene control all insect pests of cowpea?

The protection in *Maruca*-resistant cowpeas is effective against *Maruca* and some other caterpillar cowpea pests. It will not be effective against all cowpea pests.

Will foundation and certified *Maruca*-resistant cowpea seed be made available?

Yes, *Maruca*-resistant cowpea seed will be certified when sold through official seed distributors. An effective distribution system for improved cowpea seed is being investigated. In consultation with key stakeholders,



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systems to produce and distribute *Maruca*-resistant cowpea seed to farmers will be established prior to marketing the new varieties.

Is *Maruca*-resistant cowpea adaptable to farmer's cropping systems?

The *Maruca*-resistant cowpea lines will be chosen for their compatibility with local cropping systems. This improved crop will need to be effective in the local growing areas and under local growing conditions.

Can *Maruca*-resistant cowpeas be used in intercropping systems?

Yes, the *Maruca*-resistant cowpeas can be used exactly as traditional crops are used. Where traditional cowpeas are used for intercropping, the *Maruca*-resistant varieties can also be used.

Will I still need to use pesticides on *Maruca*-resistant cowpeas?

If *Maruca* is the only pest that damages your cowpea crop, then no pesticide will be needed when growing *Maruca*-resistant cowpeas. However, if other pests are a problem, some pesticide use may be necessary to protect the crop from these other pests.

Will pesticide use decrease?

Experience with other insect-resistant crops has shown that pesticide use against the target pest decreases when insect-resistant seed is

planted. Pesticides may still be needed to control other pests that are not controlled by the new seed resistance. Where pesticides will be needed, the number of sprays is expected to be fewer than usual.

Why would I need *Maruca*-resistant cowpea if I don't use pesticides on my crops?

The answer will depend on why you don't use pesticides. If you don't use pesticides because your crop is not damaged by *Maruca*, then you may not need to use *Maruca*-resistant cowpeas. However, if your crop is damaged by *Maruca*, but you don't use pesticides because they are not available, or are too expensive, or are too dangerous to apply, then you will benefit by planting *Maruca*-resistant cowpeas. The *Maruca*-resistant cowpea plants will be protected from *Maruca* damage without the need to apply pesticides.

Does *Maruca*-resistant cowpea yield better than conventional varieties?

The insect resistance will be added to traditional varieties that have good yield under local growing conditions. The addition of insect resistance will protect cowpea from yield loss due to *Maruca* infestation. Therefore under high *Maruca* infestations the *Maruca*-resistant cowpea will yield better than a conventional variety which lacks the protection against the pest. In general, insect resistance traits protect the plant from yield loss to plant-feeding insects like *Maruca*. The yield potential of *Maruca*-resistant cowpeas will be tested during the field trials.

Will the *Bt* gene protect stored seed?

The main storage pests of cowpea seeds are bruchids which are not controlled by the *Bt* protein. However, an integrated approach will be used to ensure protection of the improved cowpeas both in the field and during storage. The project plans to use farmer-preferred varieties as the recipients of the *Bt* gene. These local varieties have resistance to aphids and other enhanced traits. This combination of the *Bt* gene with well adapted local varieties will help to ensure that the improved seed is protected in the field (against *Maruca* and aphids) and in storage (against bruchids).

Will the pest develop resistance to the *Maruca*-resistant seed?

As with all pest control measures there is a possibility that the *Maruca* pest will develop resistance to the control measure. The developers will establish an insect resistance management strategy to help ensure that farmers have access to the insect resistance benefit for as long as possible. As in other countries, a key component of that strategy will involve the farmer.

Is the gene stable in the plants?

Gene stability will be tested over several generations during the field trials. The genes must be stable before a safety approval can be obtained and before the seed can be used by farmers.



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SAFETY

Is *Maruca*-resistant cowpea safe for people to eat?

Maruca-resistant cowpea is safe for both human and animal consumption. Both the *Bt* and *nptII* proteins introduced into cowpea have been extensively studied with regard to safety in food crops and no concerns have been identified. Both proteins are approved as safe by world regulatory bodies including those in the US and EU. Both proteins have been consumed in other genetically modified plants for over 12 years and have not shown any negative health effects for people.

Will the antibiotic marker gene affect human health?

The *nptII* antibiotic resistance protein was introduced into *Maruca*-resistant cowpea during the laboratory phase of the crop's development. This marker has been the subject of extensive safety reviews by national and international regulatory bodies, including the US and EU and the unanimous conclusion from these assessments is that the presence of *nptII* poses no safety concerns to humans, animals, or the environment.

Will *Maruca*-resistant cowpeas cause allergic reactions?

The insect resistance trait added to *Maruca*-resistant cowpeas is being used in insect-resistant maize varieties in 17 countries and has been consumed by hundreds of millions of people worldwide since its introduction in 1996. There are no reports of any allergic reactions from this consumption. Approval for this insect resistance trait was given by regulatory authorities in each country

following evaluation by regulatory and food safety experts. This safety evaluation included an assessment of the potential of the new trait to cause allergic reactions. The unequivocal conclusion from these evaluations is that the insect resistance trait introduced into *Maruca*-resistant cowpeas has none of the properties of any known allergen, and is not anticipated to cause any harm when consumed by humans and animals.

Is *Maruca*-resistant cowpea safe for animal feed?

Both the *Bt* and *nptII* proteins introduced into cowpea have been extensively studied with regard to their safety in animal feed, and no concerns have been identified. Both of these proteins are consumed in genetically modified plants without any negative impact on animals.

What effect will *Bt* have on pollinators?

The *Bt* protein expressed in *Maruca*-resistant cowpeas has been evaluated from an environmental safety perspective, including its potential to cause harm to pollinators such as honey bees. The insect-resistant trait demonstrates no toxicity towards other classes of insects or other animals, including pollinators. The protein has a narrow spectrum of toxicity towards lepidopteran insect pests, such as *Maruca*.

Will *Maruca*-resistant cowpeas cross pollinate with traditional cowpeas?

Cowpea is categorised as a self-pollinating crop due to the nature of its flower structure. However, pollen movement into traditional cowpea plants is anticipated to occur at a low level through the movement of insects. This is a natural occurrence with all flowering plants. The *Maruca*-resistant cowpeas will undergo a rigorous safety assessment to check their safety for consumption and the environment. This assessment will ensure that the result of pollen movement poses no safety concerns.

Will the *Bt* gene move from cowpeas to wild relatives?

Just as there is pollen movement from traditional or newly developed cowpeas into wild relatives, it is anticipated that pollen will move from *Maruca*-resistant cowpeas into sexually compatible wild relatives. The impact of this gene flow will be evaluated by regulators during their environmental safety assessment of *Maruca*-resistant cowpeas. Gene flow is a natural process and plays an important role in generating biodiversity.

Who will conduct the safety assessment on *Maruca*-resistant cowpeas?

The safety information will be collected during the laboratory studies and field trials. These studies will be conducted by the technology developers, including national programme cowpea breeders and scientists. This information will be provided to regulators for their review and risk assessment, which is conducted by experts on behalf of the regulatory agencies in individual countries. Typically, the food and feed safety assessments are conducted by scientists affiliated with the Ministry of Health and the Ministry of Agriculture, while the environmental assessment is conducted by scientists affiliated with the Ministry of Environment and/or the Ministry of Agriculture.



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TRADE

When will *Maruca*-resistant cowpea seed be available?

Maruca-resistant cowpea seeds are expected on the market around 2017. The *Maruca*-resistant cowpea is still in the testing phase. After the best lines have been identified, the safety testing will be completed and the crop will need to be approved for cultivation. When regulatory approval is obtained, a seed production system will be implemented to provide certified seed.

Will growing *Maruca*-resistant cowpeas affect trade with the EU?

Other African countries that grow genetically modified crops have not had their trade with the EU affected. It is possible to supply the types of foods wanted by trading partners through segregation of harvests. In addition, efforts are under way to harmonise EU regulation of GM crops with other agricultural countries.

Will *Maruca*-resistant cowpea affect trade among west African countries?

When *Maruca*-resistant cowpea seed is available for farmers, west African countries will each decide whether this crop will be approved for planting, import and consumption. Countries that approve the

growing of *Maruca*-resistant cowpeas will need to ensure that the seed and harvests are not taken to countries where the crop is not approved for growing or consumption.

Some countries might approve the crop for consumption, but not for planting. These countries will allow the importation of *Maruca*-resistant cowpea harvests for food and feed, but will not allow farmers to plant the genetically modified seed. The Economic Community of West African States (ECOWAS) member countries are currently developing a harmonised approach to safety assessments for genetically modified seed. Regional agreements can facilitate trade and access to *Maruca*-resistant cowpea seed for farmers.

What impact will *Maruca*-resistant cowpea have on country exports?

Maruca-resistant cowpea production will not affect the export of other crops, but importing countries may require cowpea exporters to indicate whether or not the exported crop is genetically modified. Exporters will need to notify receiving countries when exported cowpeas are genetically modified. These countries may require a safety assessment before the cowpeas are imported.

Will *Maruca*-resistant cowpeas benefit the seed business?

If there is a demand for *Maruca*-resistant cowpea seed, then this will have a positive impact on the seed businesses that will produce and distribute quality seed.

Will farmers have access to potential niche markets?

It is too early to say whether *Maruca*-resistant cowpea will provide a niche market in its own right. Farmers supplying niche markets ensure that their harvests meet the requirements of these markets through planting of certified seed and careful segregation of harvests. *Maruca*-resistant cowpea production is not expected to affect already existing niche markets established by other cowpea growers or growers of other crops.

SOCIO-ECONOMICS

Will *Maruca*-resistant cowpeas cook in the same way as conventional cowpeas?

Yes, *Maruca*-resistant cowpeas will cook in the same way as conventional cowpeas. The only change in *Maruca*-resistant cowpea is the addition of two proteins neither of which interferes with cooking nor changes the way the cowpeas must be cooked. Before the cowpeas are sold, taste testing will be used to ensure that the flavour is unchanged and acceptable.

Will *Maruca*-resistant cowpea taste the same as traditional cowpea?

The *Maruca* resistance that is being added to the traditional cowpea varieties is not expected to affect taste, because the addition of *Bt* genes



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has not affected taste in other insect-resistant crops. However, taste is one of the aspects that will be assessed before the *Maruca*-resistant cowpeas are released to farmers.

Will *Maruca*-resistant cowpeas replace traditional varieties?

Maruca-resistant cowpeas are being developed from traditional varieties. The varieties will be improved by adding only the *Maruca*-resistant trait and so they will retain all their qualities.

What are the benefits of *Maruca*-resistant cowpea compared to traditional cowpea?

The *Maruca*-resistant cowpeas have protection against *Maruca* damage in the field. Farmers will choose the *Maruca*-resistant cowpea varieties that grow best in their soil and will not have to worry about *Maruca* damage to the plants during the growing season. Fewer or no pesticide applications will be needed to control this pest. The food quality of the plants and seed will be the same as conventional varieties.

Why has field testing of the *Maruca*-resistant cowpea been started in Burkina Faso, Nigeria and Ghana, and not in other countries?

The field testing of *Maruca*-resistant cowpea was started in those countries that have working biosafety regulatory systems. The regulators in these countries reviewed the planned trials to ensure that they can be carried out safely. When satisfied with the safety of the proposed testing, the regulators gave permission for the developers to run the field trials. Countries without an operating biosafety system cannot provide a safety approval for field testing. As more countries implement biosafety regulations, it will be possible to test *Maruca*-resistant cowpea in more places.

Will *Maruca*-resistant cowpea make Africa dependent on foreigners for seed and food?

The *Maruca*-resistant cowpea is being developed by an international public-private sector consortium under a royalty free licence. The African Agricultural Technology Foundation (AATF) manages the project and collaborates with the Network for the Genetic Improvement of Cowpea for Africa (NGICA), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australia, the Institute for Agricultural Research (IAR) Zaria, Nigeria, the Savanna Agricultural Research Institute of the Council for Scientific and Industrial Research (CSIR-SARI) Tamale, Ghana, the agricultural research institute of Burkina Faso (INERA), the International Institute of Tropical Agriculture (IITA), the Kirkhouse Trust, Program for Biosafety Systems (PBS) and Monsanto, to develop, test and deploy the *Maruca*-resistant and farmer-preferred cowpea varieties.

Who will benefit from *Maruca*-resistant cowpea at local, national and international level?

The *Maruca*-resistant cowpea was developed to benefit African farmers who rely on cowpeas for food and feed. At the local level these farmers and their families are the first beneficiaries. The development and testing of the *Maruca*-resistant cowpeas has also benefited national research centres by building capacity in crop evaluation and selection. When farmers start to benefit from the *Maruca*-resistant cowpeas, it is expected that this will increase national food security and have a positive effect on wealth creation and economic stability. Thus, the *Maruca*-resistant cowpeas are expected to impact positively at many levels both locally and nationally. The international benefits will accrue when there is increased food security and sustainability of food production in African countries.

Is *Maruca*-resistant cowpea produced and consumed anywhere else?

Maruca-resistant cowpeas are being developed specifically for African farmers to address a constraint that they have identified as serious in cowpea production. This is the only insect-resistant cowpea seed anywhere in the world. Once the efficacy and safety tests are completed the seed will be made available to farmers in other countries at their request and with the regulatory approval of their national biosafety systems. However, millions of people around the world have been consuming similar insect-resistant crops safely for over 12 years.

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Will consumers accept genetically modified cowpea?

Consumer acceptance will depend on the performance of the improved cowpea varieties and the quality of information consumers receive about the *Maruca*-resistant cowpea and genetic modification. Where genetically modified crops perform well and consumers have factual information about the safety of the new crops, the acceptance levels are high. Where consumers have little experience with growing and eating genetically modified crops and hear a lot of misinformation about these crops, acceptance levels are generally low. AATF and project partners will include consumers and farmers in the evaluation of the new cowpeas so that there is a high level of accurate information about *Maruca*-resistant cowpeas in the communities where the seed will be grown and used.

What will *Maruca*-resistant cowpea seed cost?

The price for seed is generally based on the level of demand for the seed. Seed that grows well will be in high demand from farmers and may be sold at a higher price. The goal of this project is to provide improved seed for the public good in order to improve food security and contribute to poverty reduction in participating communities. The pricing should therefore support farmer access to ensure they benefit from the increased yield these seeds will offer.

Will farmers be able to save *Maruca*-resistant cowpea seeds for replanting?

Yes, farmers will be able to save seed for replanting. However, just as with traditional seed, it is good farm management practice to plant the best available seed each year to help ensure consistently good harvests. This will protect the crop from failures caused by loss in seed quality and the presence of viruses which increase each time seed is saved and replanted.

Will saved seed be as good as purchased seed?

Virus infections increase each time seed is saved and replanted, so the quality of saved seed quickly deteriorates. Certified seed, purchased from a reliable seed dealer, is tested to make sure it has very low or no virus infections. This helps to ensure that certified seed will give better harvests than saved seed.

How will *Maruca*-resistant cowpea impact on GDP?

Maruca-resistant cowpeas will impact on the GDP in the same way that a good cowpea harvest affects the economy of a country. An increased output (surplus) is expected to impact positively on the GDP, as most African countries have agricultural based economies. Cowpea is a generator of foreign exchange in west Africa, where there are large markets for both grain and fodder. Moreover, in west and central Africa cowpea grain and fodder is of vital importance to the livelihood of millions of people.

Will farmers get more income from *Maruca*-resistant cowpea?

Yes, more income is expected from *Maruca*-resistant cowpeas, because farmers using these varieties will not incur losses due to damage caused by *Maruca* in the field. Additionally, they should spend less money on pesticides to control *Maruca*. Without *Maruca* damage, the quality of harvests is expected to be higher, enabling farmers to get a good price for healthy grain and plant material.

AATF is a not-for-profit organisation that facilitates and promotes public/private partnerships for the access and delivery of appropriate proprietary agricultural technologies for use by resource-poor smallholder farmers in Sub-Saharan Africa. AATF is a registered charity under the laws of England and Wales and has been given a tax-exempt status in the USA. It is incorporated in Kenya and in the UK and has been granted host country status by the Government of Kenya where it is headquartered.