



Pod Borer Resistant
COWPEA

Why is PBR Cowpea important?

FAQs: ALL YOU NEED TO KNOW



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Technology

Why do we need Pod Borer-Resistant (PBR) Cowpea?

Farmers and scientists in Africa identified Legume Pod Borer (*Maruca vitrata*) as one of the most damaging insect pests limiting cowpea production. The damage caused by the pod borer to cowpea plants reduces the size and quality of the cowpea harvest. It can reduce grain yield by up to 80%. Farmers typically spray pesticides up to 6 - 10 times within a planting season in an attempt to control this insect pest. Farmers currently rely on the use of chemical pesticides to control this and other pests, but this is often not effective because the chemicals do not reach the pest larvae inside the plant tissues. The chemicals are also expensive, their availability to farmers is limited, and due to inadequate training in their use, often lead to unintended human health and safety impacts. A cowpea product that can protect itself from Legume Podborer damage 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 Pod Borer-Resistant (PBR) Cowpea?

The Pod Borer-Resistant (PBR) 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 attacks cowpea plants and many legume crops in Africa and other countries in the World. The *Maruca* moths lay eggs on cowpea plants and the emerging caterpillars feed on the plants and burrows into the pods. This damage affects the quantity of the leaves, flowers

and the quantity and quality of grains 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* have been and are still used as biological control agents for certain insect pests in farming, especially for 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 Pod Borer-Resistant (PBR) 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 E.U., Japan, Korea, Mexico, Netherlands, Philippines, South Africa, Switzerland, Taiwan, the U.K., the U.S. and Uruguay. The gene was identified and developed by Monsanto and is used successfully in several commercial crops.

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.

How does *Bt* insect protection work in cowpea?

The gene from *Bacillus thuringiensis*, *Bt* for short gives PBR Cowpea the ability to defend itself against *Maruca*. The *Bt* gene produces a protein that stops the functioning of the digestive system of the Legume Podborer larva which eventually dies. This protein does not affect non target organisms and as such, safe to humans, livestock, wildlife, and beneficial insects. The *Bt* bacterium is sold under different names and has been used in organic farming for over 50 years to control insect pests.

Who is developing the Pod Borer-Resistant (PBR) Cowpea seed?

PBR 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 (Bayer) 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 *PBR Cowpeas* will be carried out at African agricultural research centres in participating countries.

What institutions are working on the Pod Borer-Resistant (PBR) Cowpea Project?

The development of PBR 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.

Who is paying for the Pod Borer-Resistant (PBR) Cowpea research?

Funding support to the AATF for development of the Pod Borer-Resistant (PBR) 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.



Who does the *Maruca* resistant technology belong to?

The *Bt* gene is owned by a private company, but it has been donated to the African Agricultural Technology Foundation (AATF) for use in cowpeas under a royalty free licence. The donated technology will be used to help promote food security and poverty reduction in Africa.

Has PBR cowpea been planted anywhere else?

Bt crops such as *Bt* maize have been in the market for nearly 20 years, with more than 25 countries growing it today on 106 million hectares. However, PBR cowpea has not been commercially grown anywhere in the world. The National Biosafety Management Agency of Nigeria gave approval for commercial release in Nigeria early 2019 paving way for preparations to release the Cowpea to farmers. Trials are continuing in Ghana and Burkina Faso. Similar *Bt* products are however approved and in use in various regions of the world. In 2016, a record 185.1 million hectares of biotech crops were grown globally – an increase of 5.4 million hectares

from 2015 and more than 100-fold gain since 1.7 million hectares were planted in 1996. In South Africa, an estimated total of 2.73 million hectares of *Bt* maize was planted in 2014.

When will farmers buy and plant Pod Borer-Resistant (PBR) Cowpea seeds?

The first Pod Borer-Resistant (PBR) Cowpea seed could be available to farmers in Nigeria in the next two years (by 2021) after review and approval by the National Variety Release Committee, according to set regulations governing seed release in Nigeria. Farmers in Burkina Faso and Ghana will access the seed after environmental release approvals from regulatory agencies in those countries.

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

Yes, the Pod Borer-Resistant (PBR) 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.

Agronomy

How and when will farmers get access to PBR cowpea seed?

The seed will be produced and distributed to farmers using existing and new seed distribution channels. These channels will help ensure that good quality Podborer Resistant cowpea seed is available when farmers need it. PBR cowpea will be provided to seed companies with capacity to produce and distribute certified seeds. When sold through official seed distributors, the seed will be certified. The developer will apply for variety registration and release as per the National Variety Release rules and regulations before carrying out participatory on-farm demonstration trials with farmers. It is expected that farmers in Nigeria will have access to the seeds for planting from 2021.



Will PBR cowpea be planted the same way as traditional cowpeas, and do they need more inputs?

PBR Cowpea 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 fertilizer and water. Planting guidelines to ensure insect resistance management will be provided.

Is Pod Borer-Resistant (PBR) Cowpea adaptable to farmer's cropping systems?

The Pod Borer-Resistant (PBR) 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 Pod Borer-Resistant (PBR) Cowpeas be used in intercropping systems?

Yes, the Pod Borer-Resistant (PBR) 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 the *Maruca*-resistant gene control all insect pests of cowpea?

The protection in PBR cowpeas is effective against Legume Podborer (*Maruca vitrata*) and some other caterpillar pests of cowpea. It will not be effective against all cowpea pests. However, planting guidelines that include recommendations on integrated pest management (IPM) will be provided to farmers.

Will there still be need to use pesticides on PBR cowpea?

If *Maruca* is the only pest that damages your cowpea crop, then no pesticide will be needed when growing PBR cowpea. However, if other pests are a problem which is most likely, some pesticide use will be necessary to protect the crop from these other pests but the number of sprays will be fewer than usual. Farmers are encouraged to speak to their extension agents for best advice on type of pesticide to apply.

Why would I need Pod Borer-Resistant (PBR) 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 will not need to use Pod Borer-Resistant (PBR) 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 Pod Borer-Resistant (PBR) Cowpeas.

Does PBR cowpea yield better than conventional varieties?

The insect resistance trait will be integrated into conventional varieties that have good yield under local growing conditions. The addition of the insect resistance trait will protect cowpea varieties 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 the pod borer, *Maruca*. However, where pod borer is not a problem for cowpea production, PBR cowpea will not provide significant yield advantage.

Will the *Bt* gene protect stored seed?

The main storage pests of cowpea seeds and grains 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.

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. Farmers and Extension officers will be trained in insect resistance management.

Is the gene stable in the plants?

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



Safety

Is PBR cowpea safe for people to eat?

PBR cowpea is safe for both human and animal consumption. In Nigeria where it has been commercially released, PBR Cowpea has undergone extensive health and safety assessments as per the Nigerian and international scientific standards. The cowpea gets its insect protection ability from a common soil-dwelling bacterium, *Bacillus thuringiensis*, *Bt* in short. *Bt* products have been safely deployed and used for over 20 years in various parts of the world and have a history of safe cultivation and consumption.

Will the antibiotic marker gene affect human health?

The NptII antibiotic resistance protein was introduced into Pod Borer-Resistant (PBR) 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 U.S. 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 Pod Borer-Resistant (PBR) Cowpeas cause allergic reactions?

The insect resistance trait added to Pod Borer-Resistant (PBR) 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 Pod Borer-Resistant (PBR) 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 PBR cowpea safe for the environment?

The *Bt* protein in PBR cowpea has been evaluated from an environmental safety perspective, including its potential to cause harm to pollinators such as honey bees. The *Bt* is very specific to certain insects and causes no damage towards other classes of insects or animals, including pollinators. The protein has a narrow spectrum of toxicity towards lepidopteran insect pests, such as *Maruca*.

What effect will *Bt* have on pollinators?

The *Bt* protein expressed in Pod Borer-Resistant (PBR) Cowpeas has been evaluated from an environmental safety perspective, including its potential to cause harm to pollinators such as honeybees. 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 PBR cowpea cross pollinate with wild cowpeas?

Cowpea is a self-pollinating crop due to the nature of its flower structure which means minimal chances of crossing with wild cowpeas. However, through the movement of insects or other unknown agents, cross pollination may take place when plants are very close to each other. In that case pollen movement into wild cowpea plants is anticipated to occur at a low level. This is a natural occurrence with all flowering plants. The PBR cowpea's rigorous safety assessment carried out for both consumption and the environment ensures that the result of pollen movement poses no safety concerns.

Who will conduct the safety assessment on Pod Borer-Resistant (PBR) 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 program 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.

Trade

Will growing Pod Borer-Resistant (PBR) 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 harmonize EU regulation of GM crops with other agricultural countries.

Will Pod Borer-Resistant (PBR) Cowpea affect trade among West African countries?



When Pod Borer-Resistant (PBR) 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 Pod Borer-Resistant (PBR) 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 Pod Borer-Resistant (PBR) Cowpea harvests for food and feed, but will not allow farmers to plant the genetically modified seed. ECOWAS member countries are currently developing a harmonized approach to safety assessments for genetically modified seed. Regional agreements can facilitate trade and access to Pod Borer-Resistant (PBR) Cowpea seed for farmers.

What impact will PBR 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 Pod Borer-Resistant (PBR) Cowpeas benefit the seed business?

If there is a demand for Pod Borer-Resistant (PBR) 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?

Pod Borer-Resistant (PBR) Cowpea production will not affect niche markets established by other cowpea growers or growers of other crops. Farmers supplying niche markets ensure that their harvests meet the requirements of these markets through planting of certified seed and careful segregation of harvests. It is too early to say whether Pod Borer-Resistant (PBR) Cowpea will provide a niche market in its own right.

Socio-Economics

Will PBR cowpea cook in the same way as conventional cowpeas?

Yes, PBR cowpea is expected to cook in the same way and taste the same 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, however, culinary testing will be used to ensure that the taste and cooking qualities are unchanged and acceptable.

Will Pod Borer-Resistant (PBR) 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 has not affected taste in other insect resistant crops. However, taste is one of the aspects that will be assessed before the Pod Borer-Resistant (PBR) Cowpeas are released to farmers.

Will Pod Borer-Resistant (PBR) Cowpeas replace traditional varieties?

Pod Borer-Resistant (PBR) Cowpeas are being developed from traditional varieties so that communities will see them as improved traditional varieties rather than new varieties. The varieties will be improved by adding only the *Maruca* resistant trait, and so they will retain all of the other qualities of the traditional varieties.

What are the benefits of PBR cowpea?

PBR cowpea will provide better seed choices to farmers and help them produce more reliable harvests and better grain quality. The Cowpea will reduce pesticide use from an average of 6-8 applications during a growing season to two, which will reduce production costs for farmers and benefit both human and environmental health. Farmers who have no access to pesticides will be able to protect their grain yield through use of improved PBR Cowpea seed alone. With reduced grain yield losses, cowpea production will increase by at least 20 percent. Higher and better quality production will improve the livelihoods of smallholder farmers



and contribute to increased trade. Farmers will be able to harvest enough to feed their families, have a surplus which they can sell to increase their incomes and help strengthen local communities.

Why has the Pod Borer-Resistant (PBR) Cowpea been started in Burkina Faso, Nigeria and Ghana, and not in other countries?

The field testing of Pod Borer-Resistant (PBR) 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 *Pod Borer-Resistant (PBR) Cowpea* in more places.

Will Pod Borer-Resistant (PBR) Cowpea make Africa dependent on foreigners for seed and food?

The Pod Borer-Resistant (PBR) Cowpeas will not make Africa dependent on foreigners for seed or food. The cowpeas are being developed by an international public-private sector consortium under a royalty free licence. 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 Kirkhouse Trust, Program for Biosafety Systems (PBS), the Lilongwe University of Agriculture and Natural Resources (LUANAR) and Bayer to develop, test and deploy the Maruca resistant and farmer-preferred cowpea varieties.



Who will benefit from Pod Borer-Resistant (PBR) Cowpea at local, national and international level?

The Pod Borer-Resistant (PBR) 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 Pod Borer-Resistant (PBR) Cowpeas has also benefited national research centres by building capacity in crop evaluation and selection. When farmers start to benefit from the Pod Borer-Resistant (PBR) Cowpeas, it is expected that this will increase national food security and have a positive effect on wealth creation and economic stability. Thus, the Pod Borer-Resistant (PBR) 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.

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 Pod Borer-Resistant (PBR) 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 will include consumers and farmers in the evaluation of the new cowpeas so that there is a high level of accurate information about Pod Borer-Resistant (PBR) Cowpeas in the communities where the seed will be grown and used.

How much will PBR cowpea cost?

The PBR Cowpea will be sold at the regular price of Cowpea seed depending on the market dynamics of demand and supply. The Cowpea will be royalty-free to seed companies who will then distribute to farmers at competitive market prizes.

Will farmers be able to save PBR cowpea seeds for replanting?

Yes, farmers will be able to save seed for replanting if they wish. 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.

How will Pod Borer-Resistant (PBR) Cowpea impact on GDP?

Pod Borer-Resistant (PBR) 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.





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