



**FREQUENTLY ASKED  
QUESTIONS ABOUT  
GENETICALLY MODIFIED  
CASSAVA IN KENYA**



## Introduction

Cassava is widely grown in Kenya as a staple food, mainly by smallholder farmers. Its productivity has been declining in recent years, mainly because of crop disease pandemics, especially cassava brown streak disease (CBSD) which can cause up to 100% yield loss.

Resistance to CBSD is in high demand by farmers where cassava is grown, but it has been an elusive target for plant breeders and no CBSD resistant varieties are presently available to farmers.

Using modern biotechnology, the Kenya Agricultural and Livestock Research Organization (KALRO) has developed CBSD resistant cassava line 4046.

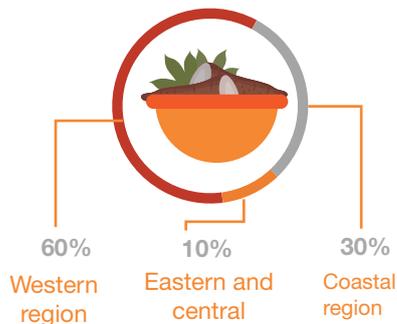
Following multiple cropping cycles over more than five years of field testing in Kenya and extensive safety studies, an

application for environmental release (open field cultivation) of CBSD resistant cassava line 4046 was submitted by KALRO to the National Biosafety Authority (NBA) of Kenya in March 2019. An approval was granted in June 2021. The approval paves way for conducting national performance trials before registration and release to farmers.

New cassava varieties that incorporate CBSD resistant cassava line 4046 and other farmer-preferred characteristics are being developed by breeders and will be distributed to farmers in Kenya if approved by regulatory authorities.

This booklet provides basic information on CBSD resistant cassava line 4046 and addresses frequently asked questions.

### Production and consumption of cassava in Kenya



Cassava Brown Streak Disease (CBSD) can result in up to

# 100%

crop loss in severe cases



CBSD resistant cassava has the potential to save

# 90%

crop damage and improve yield and marketable roots of cassava



## 1. Why focus on cassava?

Cassava is an important food crop in Kenya and performs well in the arid and semi-arid areas which make up 80% of the country's land mass area. It is the second most important food crop after maize in the coastal and western regions. Cassava survives well during drought when very few other sources of food are available. It can significantly contribute to increased food security and manufacturing pillars of the Kenya Government's Big 4 development Agenda, and the anticipated flour-blending policy.

## 2. What is the nutritive value of cassava?

Cassava storage roots and leaves are the nutritionally valuable parts of the plant. The storage roots are rich in carbohydrates, which makes them an excellent source of calories. For consumers with gluten intolerance, cassava provides a gluten-free source of carbohydrates. The leaves are a valuable source of vitamin A, vitamin C, minerals and protein.



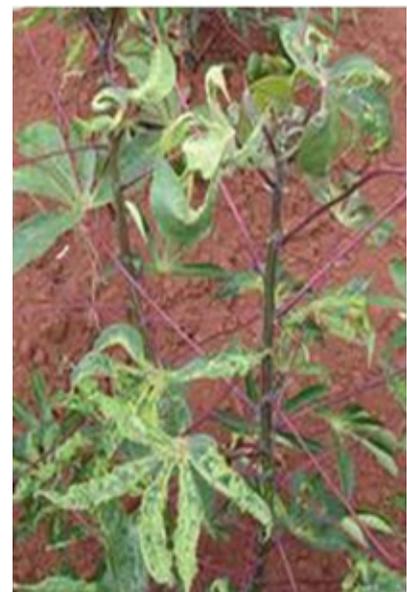
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**80%**

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### 3. What are the main cassava production challenges in Kenya?

- Cassava's productivity in Kenya faces various challenges, key among them being susceptibility to diseases and pests.
- Major diseases include cassava brown streak disease (CBSD) and cassava mosaic disease (CMD).
- CBSD is spread between plants by whiteflies and by farmers who plant infected cuttings.
- Storage roots produced by plants infected with CBSD develop brown lesions, making them inedible as food and feed and valueless in the market place.
- In severe infections, CBSD can result in up to 100% loss of usable storage roots.



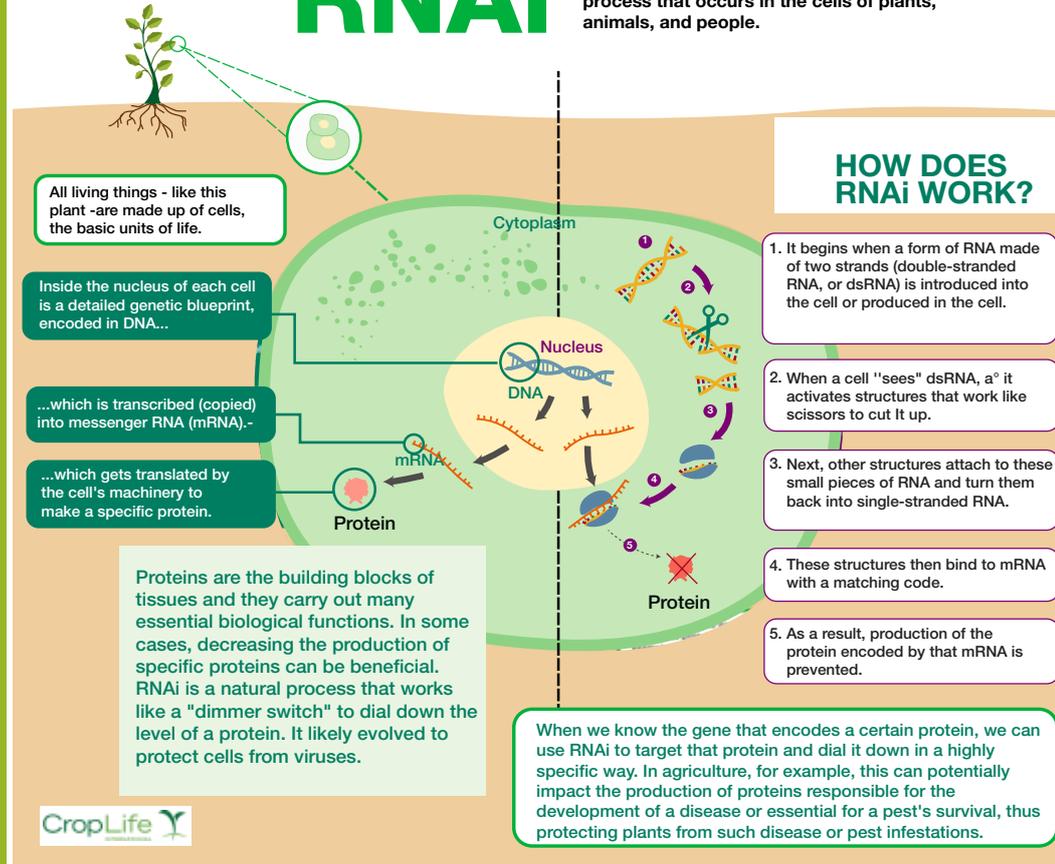
## 4. How was CBSD resistant cassava line 4046 developed?

CBSD resistance in cassava was developed by international collaboration between the Kenya Agricultural and Livestock Research Organization (KALRO), the National Agricultural Research Organisation (NARO) of Uganda, and the Donald Danforth Plant Science Center (DDPSC), USA.

Researchers introduced a small part of the two viruses that cause CBSD into the cassava plant to make it resistant. This process activates a naturally occurring plant defense mechanism present in the plants allowing them to resist CBSD. CBSD resistant cassava line 4046 was evaluated over a period of five years in confined field trials (CFTs) in five different locations in Kenya and Uganda, where it showed high and stable defence against CBSD.

# UNDERSTANDING RNAi

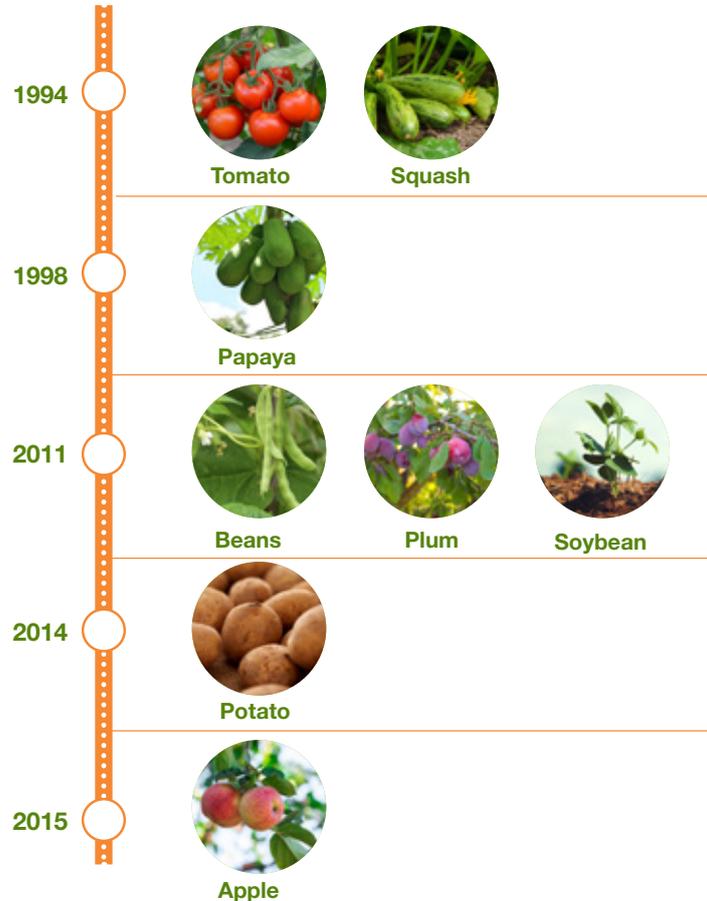
RNAi, or "RNA Interference," is a natural process that occurs in the cells of plants, animals, and people.



## 5. Why was it necessary to use modern biotechnology?

- Resistance to CBSD is one of the most important qualities for Kenyan cassava farmers.
- To date, none of the cultivated cassava varieties are resistant to the disease.
- The best CBSD tolerant cassava varieties currently available to farmers often still develop symptoms, suffer damage from the disease and are capable of spreading CBSD to new cassava fields.
- Modern biotechnology remains the best option to incorporate CBSD resistance in cassava cultivars carrying farmer-preferred characteristics.
- Similar approaches have been effective for making other crops resistant to plant viruses.
- These have been developed, reviewed, and authorized by regulatory agencies around the world, including virus resistant papaw (papaya), squash and beans.

## Some crops that have been developed using RNAi technology and approved





## 6. Who will benefit from CBSD resistant cassava?

Once cassava breeders have incorporated  
CBSD resistant cassava line 4046 into other  
farmer-preferred varieties, all players in the  
cassava value chain will benefit from CBS  
resistance through improved farm productiv  
ity, and increased quantity and quality of cass  
ava produced by Kenyan farmers.

## 7. Was there public involvement in the development of CBSD resistant cassava line 4046?

- Yes! In line with Kenya's constitution, key stakeholders such as farmers, youth, policy/decision makers, researchers and value-chain actors were sensitized through the nine-year development process.
- Over 30 events have been held at KALRO, with close to 2000 visitors to demonstration fields of CBSD resistant cassava line 4046. KALRO researchers have presented their work in several stakeholder forums.
- Going forward, farmers and communities will be involved in selecting the best CBSD resistant cassava varieties for their needs.



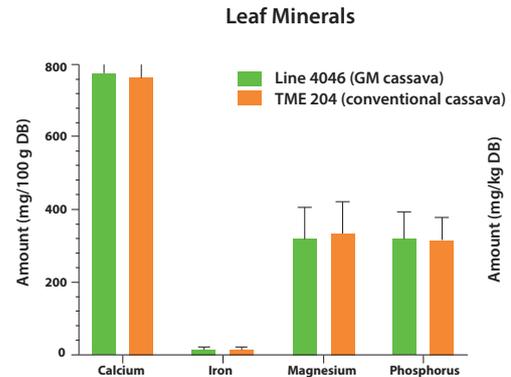
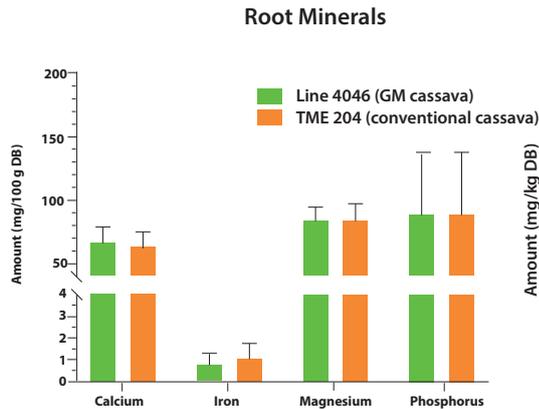
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We visited the GM cassava confined field trials in KALRO Thika. It was clear that the researchers are adhering to biosafety requirements. Before visiting the trial, majority of us had only seen GM crops in books and the internet. This visit provided a real life experience and we were impressed to see this kind of work happening in our own country, not too far from our working stations. What we witnessed was very encouraging and we could see that there is very good progress.

**Selinah Kandie, Member, Biosafety Appeals Board.**

## 8. Does CBSD resistant cassava line 4046 affect other qualities of cassava?

CBSD resistant cassava line 4046 was specifically developed to enhance resistance to CBSD. Studies of roots and leaves indicate no changes in the growth characteristics, dry matter content, composition and nutritive value. These analyses were done following internationally recommended guidelines of Organisation for Economic Co-operation and Development (OECD) and Codex Alimentarius, international guidelines on food safety which Kenya has domesticated.



## 9. Can CBSD resistant cassava be grown in any part of the country?

Breeders are able to combine CBSD resistant cassava line 4046 with farmer-preferred varieties which can be grown in all cassava-growing regions in the country.

## 10. Can CBSD resistant cassava be grown together with other crops?

Yes, cultivation of CBSD resistant cassava varieties will be the same as cultivation practices for conventional cassava varieties.

## 11. Will CBSD resistant cassava be patented in Kenya?

CBSD resistant cassava line 4046 has been developed as a public good. It will not be patented in Kenya or elsewhere. There will be no charge or restriction of rights by any of the partner institutions that have developed new cassava varieties by making use of CBSD resistant cassava line 4046.





## 12. Can farmers replant CBSD resistant cassava ?

Yes. Cuttings from CBSD resistant cassava varieties can be replanted in the same way farmers replant conventional cassava.

## 13. Have food and feed safety studies been done on CBSD resistant cassava line 4046?

Storage roots and leaf samples have been analysed for key nutritional components according to internationally recognized scientific standards for food and feed safety. Credible bodies such as World Health Organization (WHO) and Food and Agricultural Organisation (FAO) accept these standards. Overall, comparative compositional and nutritional data shows there were no significant changes for key nutritional components and anti-nutrients in the storage roots and leaves of CBSD resistant cassava line 4046 compared to conventional cassava.

## Biosafety Framework

- 2006**  
 National Policy on Biotechnology Development
- 2009**  
 Biosafety Act No.2 of 2009.
- 2010**  
 National Biosafety Authority (NBA)

### 14. Does Kenya have the capacity to assess safety of food and feed from GM cassava?

In 2009, Kenya enacted its biosafety legislation – Biosafety Act No.2 of 2009. The Act lays down legal and institutional frameworks for governing modern biotechnology. It paved way for the establishment of the National Biosafety Authority (NBA) which was officially inaugurated in 2010. The Authority is mandated to conduct overall supervision and monitoring of genetically modified (GM) crops under research, cultivation and placing on the market. In GM food safety assessment, NBA follows the relevant guidelines adopted from the Codex Alimentarius or “Food Code.” Kenya has domesticated the Codex Alimentarius in NBA’s guidelines for safety assessment of foods derived from genetically modified crops, as well as food safety standards enforced by the Ministry of Public Health.

### DECISIONS ON GMO APPLICATIONS MADE BY NBA SINCE 2010

Status	Lab/Greenhouse Trials	Confined Field Trials	Import And Transit	Environmental release (Limited)	Full environmental release
Approved	32	14	28	2 (Bt maize and CBSD resistant cassava)	1 (Bt cotton)
Withdrawn/Rejected	0	0	2	1 (Gypsophila)	0
Pending	1	0	0	0	0
<b>Total</b>	<b>33</b>	<b>14</b>	<b>30</b>	<b>3</b>	<b>1</b>



## 15. Is CBSD resistant cassava line 4046 safe for the environment and biodiversity?

CBSD resistant cassava does not confer a competitive advantage that would make cassava more weedy or invasive in the environment. It was developed for disease resistance and not pest resistance hence there are no “target and non-target species.” CBSD resistant cassava will have no negative impact on biodiversity.

## 16. Can CBSD resistant cassava cross-pollinate with conventional cassava?

Cassava is propagated by stem cuttings (stakes). The use of cuttings maintains the desirable trait combinations present in farmer preferred cultivars. Therefore, cross-pollination, though possible with other cultivated cassava or closely related wild cassava, has no negative impact on conventional cassava.

## 17. Have studies to assess stability of CBSD resistant cassava line 4046 been done?

Analysis across multiple planting seasons confirmed stability of CBSD resistant cassava line 4046 and show that resistance to CBSD is likely to remain highly effective over multiple cycles of vegetative propagation. Cassava is a vegetatively propagated crop and is therefore maintained from generation to generation through stem cuttings. This means that the young cassava plants do not undergo genetic changes through pollination.



## **18. When will Kenyan farmers be able to access CBSD resistant cassava planting material?**

KALRO cassava breeders have already begun working to develop new versions of farmer-preferred varieties using CBSD resistant cassava line 4046. Because the line is not yet approved for commercial release, this work is taking place in regulated Confined Field Trial conditions authorised by the Kenyan National Biosafety Authority (NBA). If and when CBSD resistant cassava line 4046 is approved by NBA for placing on the market, the new CBSD resistant varieties being developed by breeders would proceed through normal government variety assessment and registration by regulators and relevant authorities before being distributed to farmers.

## **19. Will there be additional costs for CBSD resistant cassava planting material?**

There will be no technology fee associated with CBSD resistant cassava line 4046 and therefore CBSD resistant cassava stakes and cuttings will cost about the same as any other highly-valued cassava varieties. The production, multiplication and distribution of planting material will follow the same process as all other cassava varieties released by KALRO and other stakeholders.



## 20. What is the economic viability of CBSD resistant cassava?

CBSD resistant cassava varieties will not be different from their conventional equivalents except for the ability to resist CBSD. Due to the ability to resist CBSD, these varieties will be more productive with better quantity and quality of root yields. This will translate to greater demand and more profits for cassava farmers. CBSD resistant cassava line 4046 will also produce disease-free planting material and thereby contribute to long term sustainability of the cassava crop.



more food

better nutrition

higher incomes



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