CEREALS

The leading journal for field crops

October -December 2022

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Unlocking GMOs

His Excellency Dr.William Samoei Ruto

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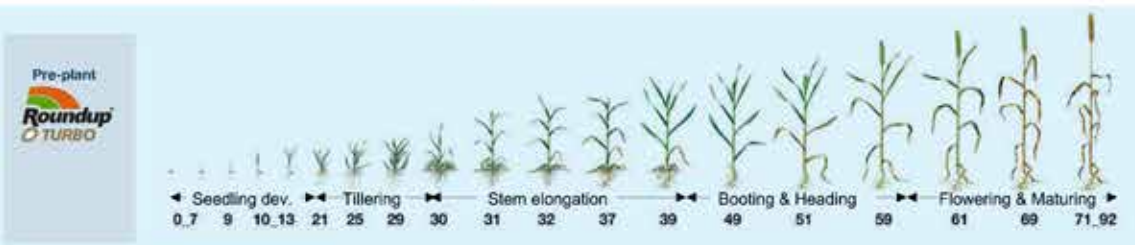

Pre-plant	Roundup TURBO				
Seed Treatment	Seed and soil Borne fungal diseases	Deter (2ml per kg of seed)			
Grass control	Annual grasses except broms grass		Ralon (1lt per ha)		Can be tank mixed with Huskie
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Insect pests	Aphids, bollworms & others		Tihanox 0.3-0.4lt per ha		decis Forte 125ml per ha
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Nutrition	Macro & micro nutrients deficiency		WUXAL Macromix 24.24.16 1.0lt per ha		

NB: Scouting for insect is important. Spray when three to four larvae of bollworms are found per walking meter. Target the early instar stages of caterpillars.

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Editorial

Which Way GMOs?

Presently the yields of most major crops are stagnating while the demand for food, both grain and animal protein, is growing. To meet the challenge of improving yields requires a constant commitment to generating a steady supply of improved cultivars and lines for all major crops.

While it's possible to naturally give foods desirable traits through selective breeding, this process takes many generations. Also, breeders may struggle to determine which genetic change has led to a new trait.

Therefore, conventional breeding cannot keep pace with what is required; to meet the targets biotechnology and the production of genetically-modified (GM) crops is filling the gap.

Genetic modification significantly accelerates this process by using scientific techniques that give the plant the specific desired trait.

The main concerns around GMOs involve allergies, cancer, and environmental issues — all of which may affect the consumer. While current research suggests few risks, more long-term research is needed.

All said, the future is very promising for GM technologies to enhance our efforts to meet the future global needs for food, feed and fibre in a sustainable and responsible way.

Masila Kanyingi
Editor

Cereals **EDITOR:** Masila Kanyingi **SUB-EDITOR:** Mary Mwende Mbithi **EDITORIAL ASSISTANT:** Cornelius Mueke **CONTRIBUTORS:** Dr. Murenga Mwimali, Louise Impey, Dr. Bitange Ndemo, Ruth Vaughan, David Jones, James Karuga, Professor Hamadi Boga, Dr. Bimal Kantaria, Jane Muia **PHOTOGRAPHER:** Alexander Mainga **GRAPHICS DESIGNER:** Evelyne Ndiema **MARKETING:** Florinews Ltd **ADMINISTRATION ASSISTANT**: Christine Muthoki

EDITORIAL BOARD: Nicholus Mbatha - Corteva, Doris Kawira, Joseph Kioko, Maina Ngunju- Bayer East Africa, Martin Mwobobia - Consultant

ADDRESS: P.O.BOX 79396 - 00200 Nairobi. **TEL**: 020-2440909 • **CELL** 0732-558172, **EMAIL**: info@cereals co.ke **Website:** www.cereals.co.ke

Time to Trust Our Scientists

Regardless of scientific consensus and countless studies endorsing the safety of GM crops, What else do you need. What Will it Take to Trust Scientists on GMOs?

Dr. Murenga Mwimali

Africa continues to lag behind in adoption of biotech crops. In 2016, only two of the 26 countries that planted biotech crops were from the region. Yet, the continent stands to benefit immensely from application of modern biotechnology in agriculture. Reluctance to adopt the technology is partly attributed to safety concerns, heightened by strong activism propagated from the west, by countries that don't face the same challenges that we do. An example is of Kenya, where for long., agricultural researchers had raised concern over government failure to provide enabling environment to facilitate adoption of new improved crop varieties.

The researchers have said that more efforts is needed to enable Kenya Agricultural Livestock and Research Organization (KALRO), Kenya Plant Health Inspectorate Service (KEPHIS) and other regulatory institutions to avail improved crop varieties to small scale farmers, including biotech GM maize, and GM cotton. Thanks to, Kenya's President, H.E Dr. William Ruto was spot on, in his 2010 COP-MOP 5 address, when he challenged "those with the luxury to choose whether to have red meat, white meat or whatever other colour meat not to stand in the way of those who are simply asking to have a meal" He has led the path and adopted the technology in Kenya.

The researchers in Kenya Agricultural Livestock and Research Organization (KALRO) have been conducting GM maize research since 2004 in confined field trials in Kiboko,

Makueni County in the KALRO farm. The demonstration illustrate that use of GM maize can make a contribution to the many options that the farmers can chose from in cushioning themselves against the current challenges of drought, pests like the recent fall army worm and diseases .

Recently, a team of scientists published a meta-analysis on impacts of genetically modified (GM) maize on the environment, agriculture and toxicity. The data generated over 20 years concluded that genetic engineering increased maize yields by 10% on average, and reduced conventional mycotoxins in maize. This multiple data analysis provides very reliable evidence that GM maize can tackle a serious problem that has afflicted the continent for a long time – aflatoxin! Less amounts of natural mycotoxins reported to be both poisonous and carcinogenic to living organisms (humans and livestock) were observed in GM maize compared to their conventional counterparts. The study, like many before it, endorse the safety of GMOs.

In 2016, the US National Academy of Science published a report on GMOs which reinforced the scientific consensus that there is no substantial evidence that GM crops are less safe than non-GM crops. The question that lingers on my mind is this: how many studies will it take for our leaders to trust scientists?

Regardless of scientific consensus and countless studies endorsing the safety of GM crops, there is widespread public perception that they are not safe. Worse still, some African governments have even hampered their production, only to allow imports of food and feed resulting from or containing GM products! This only benefits farmers from adopting countries and indirectly affects research progress, further delaying access to improved seeds. This is a worrying trend in a continent viewed as the final frontier for agricultural transformation to bring back the massive unemployed youth into smart farming.

It is disheartening when those entrusted with the responsibility of making key decisions about this continent's food and nutrition security, continue to let half-truths impede them from taking decisive action. They shy away from making evidence-based decisions and developing facilitative policies that can enable this viable technology to blossom! Two decades after the technology has proved itself both in terms of safety and delivery of socio-economic benefits, some of our leaders continue to hide behind precautionary measures and demand for "never-ending research."

There is evidence too that the more the stacks (GM crops containing more than one trait of interest), the better, with over 25% yield increment. In the same vein, no significant impacts have been observed on non-target organisms and other beneficial organisms including bees, ladybirds, beetles, lacewings and spiders. In previous data analyses, it has been documented that adoption of GMOs reduces the use chemical pesticides by about 37% compared to their conventional counterparts. Why then would our leaders want to come in the way of people enjoying such benefits, long after safety concerns have been put to bed?

African leaders need to care about this study and others that have endorsed safety of GMOs in the past and let credible scientific evidence guide them in decision making. In Africa, we have many collaborative initiatives on GM crops under various projects for example; Water Efficient Maize for Africa (WEMA), GM cassava and banana, Africa Biofortified Sorghum, Bt cotton, and others that continue to face regulatory bottlenecks leading to serious opportunity costs on farmers and their families. What is the scientist supposed to do beyond providing evidence that the technology works?

Reflecting on Science, Society and GMOs

Several countries are using biotechnology to develop drought and disease resistant crops, but there are major obstacles getting them to market.

African researchers are racing to find solutions to protect crops and ensure food security for the continent.

The GM controversy

Beyond rejecting GM technology based on unfounded health risks, there are hefty concerns about the power concentration in the biotechnology market, best exemplified by the antipathy towards companies like Monsanto and Bayer. Despite strong public demands to act upon monopolistic market structures, leading political parties often defend and support powerful multinationals. Van Montagu, among others, argues that it is the lack of alternative narratives that leads to this contradiction:

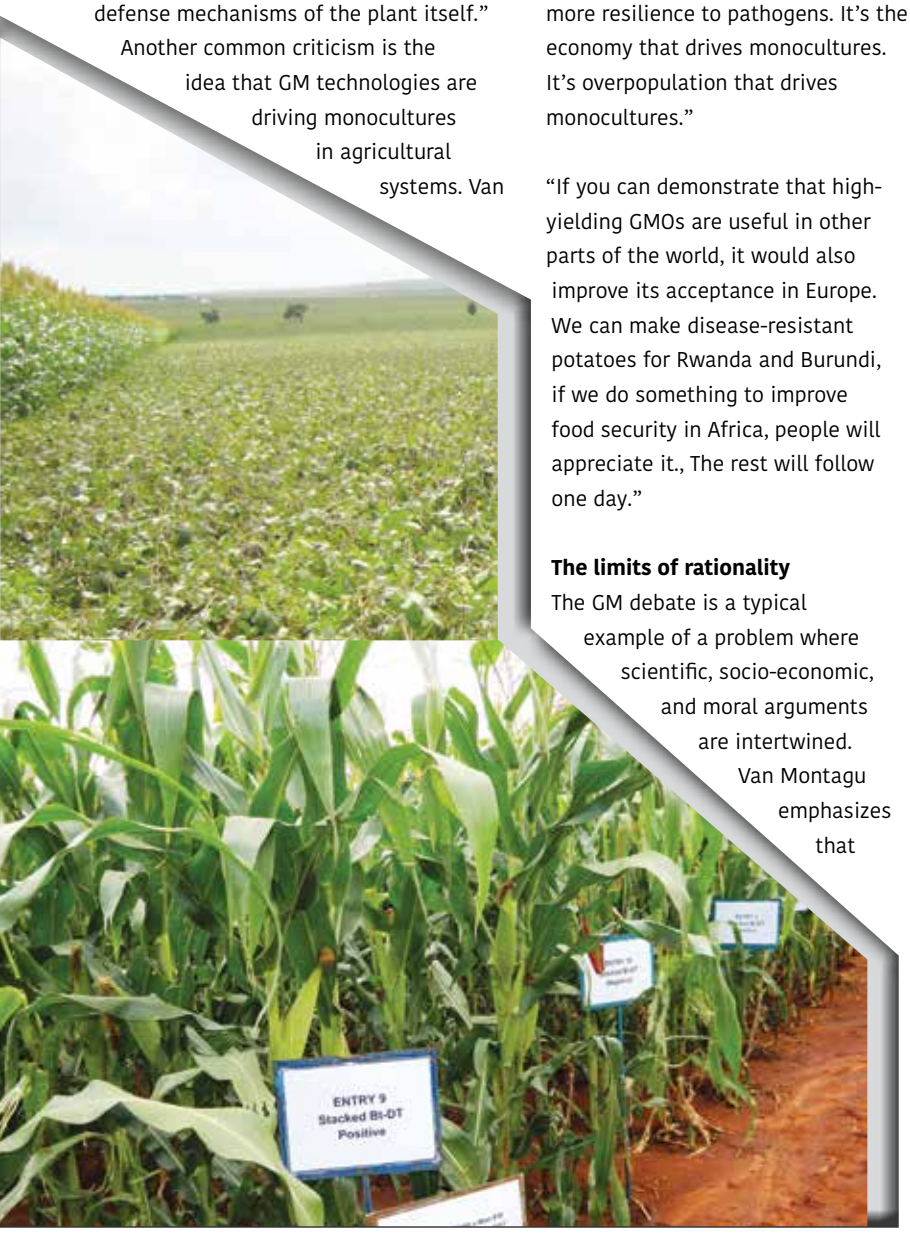
"Multinationals have the physical and financial power. Why are so many people from liberal and conservative parties supporting multinationals? Because they believe that you cannot do it otherwise. They believe that you need some 'industry captain': some sort of dictator leading the corporation. Nevertheless, I do believe that you need persons with initiative, not inhibited by the fear of the unknown."

Van Montagu emphasizes that it is worthwhile to question economic ideologies with profit maximization as its ultimate goal. However, the common confusion of technologies and their potential on the one hand, and the market

structures they are embedded in on the other, seems to block much-needed diffusion of technologies that have the potential to sustainably intensify agriculture and thereby reduce the use of chemicals and minimize pressure on ecosystems and biodiversity.

"All these pesticides change the composition in the soil, thereby possibly harming the soil microbiome. There are certainly arguments to use less chemicals in agriculture. It's better to harness the defense mechanisms of the plant itself."

Another common criticism is the idea that GM technologies are driving monocultures in agricultural systems. Van Montagu rejects this idea without being less critical of the dominant role of monocultures:



"There were monocultures in agriculture a long time before GMOs appeared. Monocultures are always negative. Agrobiodiversity, cultivating a lot of different crops and varieties, is obviously important. If you see how plant diseases evolve, how plants defend themselves to diseases, the more varieties, the more resilience to pathogens. It's the economy that drives monocultures. It's overpopulation that drives monocultures."

"If you can demonstrate that high-yielding GMOs are useful in other parts of the world, it would also improve its acceptance in Europe. We can make disease-resistant potatoes for Rwanda and Burundi, if we do something to improve food security in Africa, people will appreciate it., The rest will follow one day."

The limits of rationality

The GM debate is a typical example of a problem where scientific, socio-economic, and moral arguments are intertwined. Van Montagu emphasizes that science, society and daily life are three different things. The first deals with our physical world, the second is about establishing rules to make sure that all people can live together, and the last is about what makes our individual lives interesting — what we love, what gives us pleasure. We cannot ask all people to learn science. According to Van Montagu, that would be a silly rationalist idea.

Furthermore, the people that do have a scientific vocation have to be modest:
"I believe that we still don't know the most of our physical world. All that we know now pales in comparison to what we still have to discover."
Even when we establish certain concepts by scientific analysis and rational thinking, sticking to our theories, concepts or ideas is not without danger:

"A lot of horrors were committed in the name of rational thinking. When you have an idea, which you consider to be logic, you always end up with the dictatorship of that idea, because you're not flexible enough to challenge it. In the 1920s, genetics became eugenics because that was something society could understand: that there's something genetic that discerns good from bad. If that is true, you could distinguish superior people from inferior people. People were doing this pseudoscientific eugenics research in Sweden, the United States and later, in the thirties, in Nazi Germany."

People often assign moral attributes to nature that are simply not there, which is another pitfall to avoid: "We feel what is good and what is bad, influenced by religion, society, political parties. This is very different from what nature is, from the real facts. Nature doesn't know good or bad, that's a concept that we created by living in society. Nature is there, you can observe it, and you can use knowledge of our natural world to create tools. The limited things you can really call bad are what threaten the society."

Van Montagu stresses it's important to avoid

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quick moral judgments. Moreover, we should all be critical of ourselves, constantly questioning our beliefs, prejudices, and ideas.

"We are all tricked by our own attitudes, we all have our biases. We are all imperfect: that is something crucial to realize." Although we have to be rational when we analyze things, it doesn't mean that we can be rational all the time. Intuition has a great value:

"What gives us pleasure? What makes our lives qualitative? People enjoy their beliefs. People love science fiction. They love horror stories. You can enjoy all kinds of stories and still be rational. People should enjoy arts and stories, with all their fantasies. To some extent, the negation of science is amusing, as a story. We express ourselves with words that can be interpreted in so many ways. In society, there's no black and white. Artists feel that two opposite things can be true at the same time. Some people say that artists are not social. Actually, they are very social. They know that there's no black and white; they feel all nuances of life, almost like a shaman. Just with music and rhythm, people can enter a state of trance. We all have it in us."

Role of science in society

In order to further build on the considerable advancements science has made to our everyday life, Van Montagu indicates the importance of flexibility in science:

"The ethics of science are different from the ethics of everyday life. See that you do everything correctly, stress the facts, be ready to change your ideas if needed, if observations or other work point in another direction."

When it comes to the interaction between science and the broader society, Van Montagu sees a more active role by scientists as desirable. He stresses that the way in which scientists communicate is crucial, especially when it comes to sensitive topics like the environment, where both emotions and private interests can play a significant role:

"Talk about it, try to find the right words. People who are destroying natural ecosystems make money with doing so. You have to name this: these people are exploiting nature. If you can phrase it in a way that people pay attention, you can make a difference. However, you should avoid power arguments: 'I know better, so I decide.' Even if you find a very inconvenient truth." Further elaborating on the limited diffusion of promising innovations, Van Montagu underlines the importance of a more frequent and intense exchange between social and natural sciences:

"There's an enormous need for sociological research on how to bring innovations to industry, and how the industry should deal with it. What people call 'laws of economy' are not like laws of nature. They are things that are constructed through ideology." Beyond his call for interdisciplinarity, Van Montagu emphasizes the need to broaden the curriculum of natural science students with aspects from social sciences:

"Something immensely important for universities is that one should also teach exact science students about society. What is society? What is sociology? What is economics? This is important to understand how decisions are made in the world."

Finally, in an academic world where knowledge is highly available and accessible through university libraries, online courses, etc., Van Montagu highlights the critical need for instructors to shift from their traditional focus on knowledge transfer and instead promote reflection. The call for more debates and discussion around existing knowledge, and the way our societies deal with it, appears essential in an era where we see miseducation, misinformation and populism on a steep rise.

H.E Dr. Ruto Unlocks GMO

The Cabinet unlocked billions for firms involved in the genetically modified organisms (GMO) industry after it approved the farming and importation of biotechnology crops in a major policy shift that seeks to make Kenya food-secure and contain runaway prices.

President William Ruto chaired a cabinet meeting that lifted the 2012 moratorium that restricted importation or open cultivation of GMO crops, making Kenya the second country in the continent after South Africa to allow biotechnology foods.

The approval comes in the wake of a biting drought that has exposed three million Kenyans to famine in 23 counties, forcing the government to intervene with relief food. Firms involved in GMO seed manufacturing will be some of the biggest beneficiaries of the policy shift that will put pressure on farmers to reduce prices or be forced out of the market.

The approval is meant to allow imports of GMO maize that are readily available in the market at a cheaper cost to help in lowering the price of flour which has now hit a high of Sh200 for a two-kilo packet as the new government drops the subsidy scheme, which Dr Ruto termed as costly to the economy.

In consideration of the adoption of GMO crops, the Cabinet said it put into mind various expert and technical reports including that of Kenya's National Biosafety Authority (NBA), the World Health Organisation, the Food and Agriculture Organisation, United States of America's Food and Drug Administration (FDA), and the European Food Safety Authority (EFSA).

"In accordance with the recommendation of the Task

Force to review matters relating to Genetically Modified Foods ... the Cabinet vacated its earlier decision of November 8, 2012, prohibiting the open cultivation of genetically modified crops and the importation of food crops and animal feeds produced through biotechnology innovations. "Effectively lifting the ban on Genetically Modified Crops, by dint of the executive action open cultivation and importation of white (GMO) maize is now authorised," read a Cabinet memo.

Scientists argue the GMO maize variety can yield double what farmers are getting from the conventional breeds given that they are drought tolerant and can withstand pests and diseases.

Timothy Njagi, a research fellow with Egerton University-based Tegemeo Institute, says the decision was long overdue.

"GMO maize is cheaper than the conventional one and once we start importing it will lower the cost of food locally," said Dr Njagi.

Dr Njagi said GMO imports will also help in addressing the high cost of animal feeds, which have for the last three years remained at a historic high. The waiver on GMO imports, he said, will now see millers import other non-conventional materials used in making feeds such as soya.

Dr. Roy Mugiira, the chief executive officer of the NBA, which is the sector regulator, welcomed the move by the Cabinet. "In the coming few days, we shall now be issuing guidelines to be followed in importing or growing of these varieties, but I can say that it is now legal to have GMO crops in the country," said Dr Mugiira.

The ban on GMOs was announced by former Health Minister Betty Mugo in 2012 after a journal by French scientist Eric Seralini claimed that these crops had a link to cancer after a mouse that was fed on it developed a cancerous tumour. The journal was, however, recalled two years later on grounds that it was not conclusive on the matter.

GM maize testing in Kenya started in 2010 but approval for the environmental release was granted by the NBA in 2016. The scientists completed research on genetically modified maize last year and the material has been awaiting approval by the Cabinet before release for commercial farming.

GMO Maize

KALRO has done a lot of work in sensitizing farmers, politicians and other stakeholders on the importance of GMO products in Kenya through testing Bt maize in confined field trials (CFTs) in Kiboko and Kitale. Bt maize materials in the CFTs have proven to be resistant to insects and drought as compared to the other conventional materials.

What is GMO Maize

Maize whose genetic material has been altered by means of genetic engineering in order to favour the expression of agriculturally-desirable traits including resistance to pests, herbicides and drought tolerance.

Why shift and plant GMO maize

GMO maize can be used because of the following reasons;

a) Insect Resistance

Bt Maize is modified to include genes borrowed from a soil bacterium called Bacillus thuringiensis. The bacterium produces a crystal, Cry, protein that disrupts the gut of insects that ingest it. Bt maize now possesses the insect-killing ability, and shows tolerance to Fall Army Worm. Maize can now be grown where infestation previously destroyed harvests or required large doses of toxic pesticides pumped into the environment, often killing beneficial insects in the process.

b) Disease Resistance

Maize is subject to plant diseases, including fungi and bacteria. While all plants are susceptible to some diseases, some plants can resist diseases that attack others. Another benefit of GMO maize is described in an International Council for Science, ICSU, report cited by the "Public Library of Science-Biology." Corn bioengineered to carry disease resistance genes from naturally resistant plants contain lower levels of mycotoxins, substances produced by fungi growing on insect-infested, non-GMO corn crops. Myxotoxins are potentially carcinogenic to humans.

c) Herbicide Resistance

Agronomists reporting for AgBioWorld describe glyphosate, brand named Roundup, as an example of a weed-killing pesticide to which GMO maize has been made resistant. Similar GMO maize benefits have been developed for other pesticides.

d) Nutritional quality enhancement

Nutritional quality of food crops can be improved through modern biotechnology. Critical micronutrients (the vitamins and minerals that people need for good health) are enhanced. These micronutrients can be provided to millions of people through the staple foods that they eat every day, foods such as maize, sorghum, sweet potato and wheat. While these staples are often packed full of energy, they usually lack essential micronutrients such as vitamin A, iron and zinc. When people don't get enough of these micronutrients, they suffer from a hidden hunger. This puts them at increased risk of stunting, anemia, blindness, infectious diseases and even death. Women and children are especially vulnerable.

Its Production compared to current production?

According to the results on drought tolerance and insect pest resistance experiments carried out at the Confined Field Trials in Kiboko and Kitale, GMO maize has a yield advantage compared to non GMO maize. The GMO maize also proved to be resistant to Fall Army Worm.

Why all the hullabaloo from NGOs and other activists

There has been a lot of debate in Parliament .The debates have been due to misunderstanding and lack of proper information on GMO. The conflict of interest from the multinational companies and the fear of change has also majorly contributed to these debates. However, the Government of Kenya through various initiatives including BioAWARE, Biotechnology Sensitization workshops at county levels, schools' biotechnology sensitization meetings, The Science Centre initiatives with schools, and other publics, Open Forum on Agricultural Biotechnology (OFAB), and other have contributed strongly in informing the public on importance of biotechnology and its applications.

Why was the government slow to embrace the technology (Political or Scientific reasons)

Kenya has all the Acts that guide biotechnology applications eg the Biosafety Act of 2009. Kenya too has the Biotechnology policy development of 1986. In addition the country has NBA, KEPHIS, KWS, KIPI, DVS, PCPB, KEBS, aond others as competent authorities that will in all ways guide the agribiotechnology applications and deployment. However, it is not known why there was a long delay in the use of crop GMO's? There is a challenge that with a small groups of anti-GM activists who object to the technology on "moral" grounds. They typically claim that GM crops are unsafe - a view flatly rejected by the scientific community over the last two decades

Its market and consumption (effects if any to consumer or environment).

GMO maize seed will be availed to the farmers through local seed companies at prevailing market prices (demand and supply) like any other commercially available improved seeds.

What advice can you give to Kenyans (Farmers and Consumers) on GMO.

The use of Bt maize is not a silver-bullet solution to all our food insecurity challenges, but has potential to contribute towards reduced suffering of the food deficits especially due to maize. By deploying Bt maize products Kenya has the potential of solving food insecurity problems. KALRO has done a lot of work in sensitizing farmers, politicians and other stakeholders on the importance of GMO products in Kenya through testing Bt maize in confined field trials (CFTs) in Kiboko and Kitale. Bt maize materials in the CFTs have proven to be resistant to insects and drought as compared to the other conventional materials.

Why Farmers Need to Carefully Monitor Yellow Rust in Wheat

The surge in yellow rust is becoming a bigger challenge for agronomists and farmers.

By Louise Impey

The disease takes its name from the highly visible parallel lines of yellow-orange pustules that are produced along the leaves of adult plants. New races of the pathogen and unexpected infections on previously resistant varieties have caused well-documented control difficulties in the field, with growers being warned to "expect the unexpected" from such a highly diverse pathogen.

As a result, the way that variety resistance ratings for yellow rust are calculated has been changed this year, with greater emphasis being given to the most recent results.

In addition, an on-line "watch list" of varieties considered to be at greatest risk and most likely to perform differently to their ratings has been published by the AHDB, giving an early in-season warning of any problems.

The problem

The most severe yellow rust epidemics are usually associated with the perfect storm of very susceptible varieties, mild winters and cool moist summers, with yield losses of 40-50% being recorded where varieties do succumb.

The disease – which was known for being sporadic has been seen at much higher levels in the past couple of years.

This surge is due to the arrival of new, more aggressive races of yellow rust in the field – up to 10 were identified last year – which have been able to overcome some of the genetic resistance found in popular varieties.

Experts warn that the fluidity of the situation and the potential for further change from an increasingly diverse pathogen population mean that it is impossible to predict what will happen next.

Its diverse and dynamic nature also means that yellow rust has shown variation across sites and seasons.

As a result, popular winter wheat varieties have seen their disease resistance ratings revised, with some dropping by as much as three points.

Risk to crops

Against this background, it is essential to monitor crops and report any unexpected findings as the season develops. As Jonathan Blake, associate director at Adas points out, yellow rust continues to be a complex and moving scenario, so there will be implications for its management and control.

"The yellow rust situation in the UK is very dynamic," he says. "The variety ratings are as accurate as they can be, but don't assume anything. It takes time to detect and confirm new races, which is why the information we have can seem to be behind what's happening in the field."

These variety ratings are now weighted. Although they are still based on a three-year data set, the most recent year's results have the largest influence.

Introduced for 2021, they are being combined with an advanced warning system, to give growers greater guidance.

How it spreads

Yellow rust requires living green plant material to survive. It can overwinter as dormant mycelium or active sporulating lesions, either on volunteers, late green tillers or early sown winter wheat crops. It then appears as distinct "foci" in crops and can be

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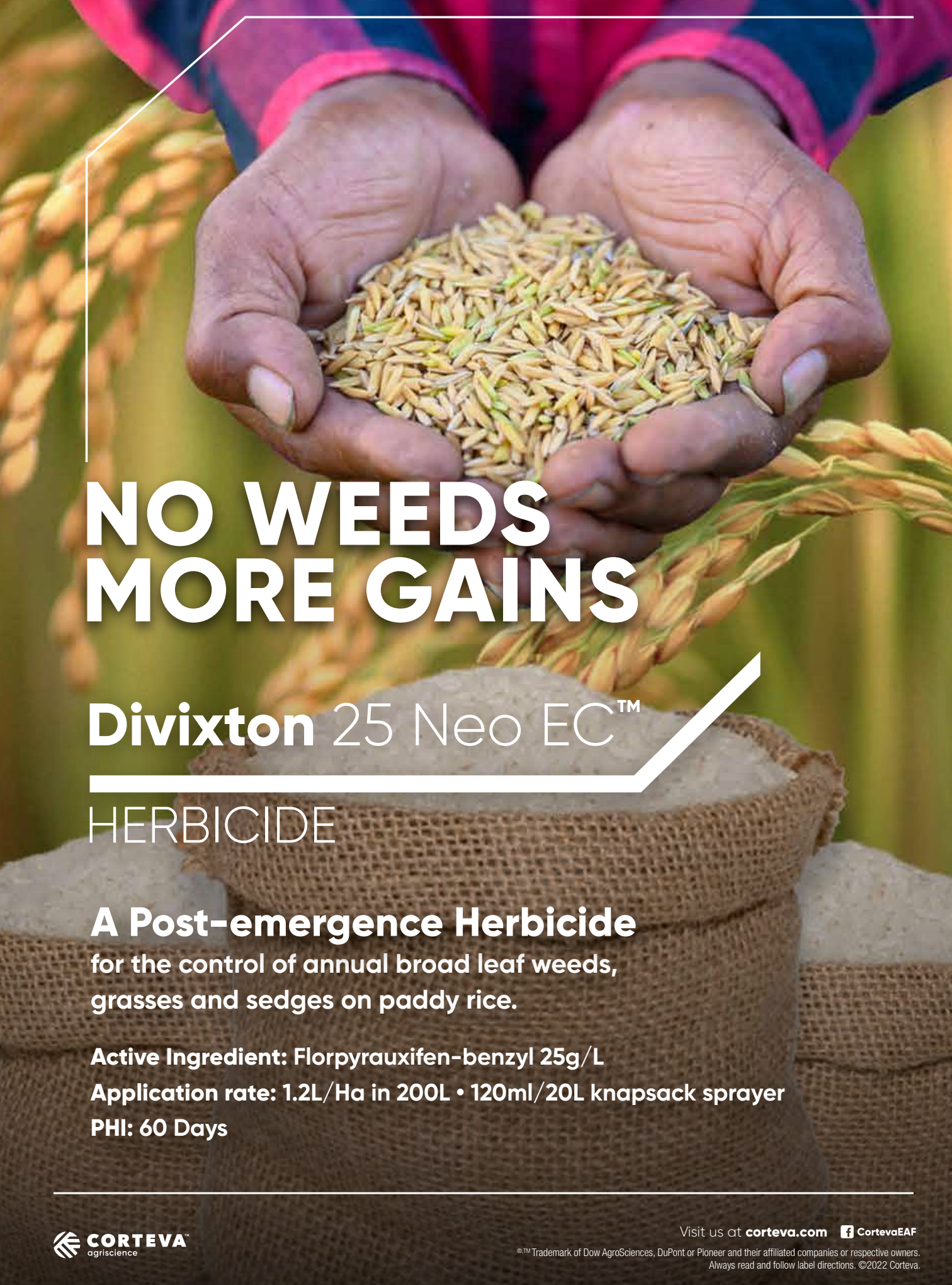

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spread over long distances by the wind.

Once within plant tissue, yellow rust can survive the coldest of climates.
As it warms up, the fungus starts to grow and produces active sporulating lesions, with the ideal growing conditions being at temperatures of between 8-15^{0}C. Cool, damp weather is conducive to its development.
Perfect conditions, the complete cycle from infection to the production of new spores can take as little as seven days.

This means the disease cycle can be repeated many times in one season.

The fungus may be inhibited by temperatures over 20^{0}C, although some experts believe that the new strains of yellow rust are tolerant to a wider temperature range.

If these are lost to the cold, so too is the infection.

In contrast, mild winters increase the likelihood of the disease surviving, leading to early infection. While a cold winter helps to delay the epidemic, it won't stop it.

Despite the arrival of new races, varietal resistance can still be a useful option in limiting the incidence and spread of yellow rust, forming part of an integrated approach.

Resistance is measured at the seedling stages and also at the adult plant stages – varieties can be susceptible in the early parts of their life, but resistant at the adult stage.

The Recommended List ratings reflect adult plant resistance. "It's the adult stage that

Yellow rust management
Contrary to previous thinking, early sown crops are not at greatest risk from yellow rust.

"We've been able to show that later-sown crops have more yellow rust, which can be explained by the relationship between the pathogen and plant age," says Mr Blake.
The number of frosts below -5^{0}C also has a bearing on its development, as yellow rust clings to the lower leaves in the winter.

really counts, even though it doesn't kick in until later in the growing season. The timing of this varies between varieties, but has always happened by growth stage 39," says Mr Blake.

What makes the new discoveries different to the older, established races is that they seem to produce more spores and cycle more rapidly when they are in wheat crops.
"They certainly behave more aggressively in the field, producing serious yellow rust. As a result, they push the epidemic more quickly."

Later-sown crops can have more yellow rust.
Fungicides
There is a good choice of fungicides for controlling yellow rust, which, unlike septoria, includes the strobilurins. When planning their strategy, cereal growers should aim to be one step ahead of the disease, rather than having to react to it.

That means the early spray timings are important if the disease is already present.

Unfortunately, because having a good resistance rating is no indicator that a variety will remain clean, there is a need for vigilance as the crop develops.

There are choices with fungicides. A strobilurin will dry out any rust that's present and give two to three weeks' protection, while an azole is preferred if the yellow rust is established.

For Mr Blake, the decision on product choice for yellow rust at the early stages is clear.
"The best performing azoles offer curative activity, so they should be the first choice where yellow rust is active.

"The strobilurins are more protective than curative, but are behind the azoles in terms of performance. They have a place where protection is required." adds Mr Blake.
"They're less effective on yellow rust than they are on brown rust."

By the time you get to the T2 spray, there will be yellow rust activity provided by an SDHI/azole combination, which is a fairly standard treatment at that stage, he notes.

"What's important is that you are using a robust rate of azoles, with 80% being the minimum. This, along with good spray timing, is essential."

Source : Farmers Weekly

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Dr. Bitange Ndemo

How to Grow More Food For a Growing Population

The "Big Four" agenda focused on food security, affordable housing, manufacturing and affordable healthcare as key pillars anchoring former president's development policies during his second and final term in office. President Dr. William Ruto seems to be focused on the same. **Dr. Bitange Ndemo** critically looks at them

Let us critically analyse each of the pillars and make suggestions on how best we can achieve these goals starting with the first pillar -- food security. Food security is a vital cog in the economic growth of any country. The Food and Agriculture Organization (FAO) defines food security as a state "when all people have physical, social and economic access to sufficient, safe, and nutritious food that meets dietary needs and food preference for an active and healthy life at all times."

Population and Land

Without such in any country, there will be social and economic instability.

There are several variables that impact food security. Key among them is population and land resources. , Kenya's population is around 51 million, more than 13 million new lives since the last census of 2009, when the country had 36.8 million people.

If you carefully scrutinise the population density and the climate maps below, you can see that they mirror each other. In other words, the density of the population is higher in the most arable land inhabited by largely peasant farmers who own small pieces of land.

Yet, according to FAO, smallholder farmers contribute more than 80 percent of food supply in Africa, as well as in Kenya. The nexus between population, land size and productivity was the subject of a 1997-2010 study by Milu Muyanga and T.S. Jayne in their paper Effects of Population Density on Smallholder Agricultural Production and Commercialization in Rural Kenya, through a grant from the Bill and Melinda Gates Foundation to Michigan State University's Department of Agricultural, Food, and Resource Economics.

The study established that "farm productivity and incomes tend to rise with population density up to 600-650 persons per km2; beyond this threshold, rising population density is associated with sharp declines in farm productivity."

Minimum Land Size

At the time, "14% of Kenya's rural population was residing in areas exceeding this population density." Although no new study has been undertaken, the additional 13 million people must

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ETG

ETG's range of fertilizer blends

Planting Blends

Top dressing Blends

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have pushed the percentage of Kenyans living in areas that they will experience drastic productivity decline.

The study concluded that Kenya needed to explore the nature of institutional and policy reforms needed to address these development problems. Indeed at the time, the then Lands minister Amos Kimunya came up with a policy on minimum land size but political pundits destroyed it before the public debated it.

As a result, there isn't much arable land in Kenya where farm mechanisation can help improve productivity. In my view, for Kenya to be food secure, it is necessary to discourage further land subdivision and possibly start land consolidation to enable large-scale mechanised commercial production to meet the needs of the growing population.

Danger of Relying on Peasant Farmers

The danger of the continuing reliance on peasant farming is that a few Lords of Poverty have mastered ways of manipulating small-scale farmers and carting away huge sums of money. Every year, we are told that farmers will get fertilizer but no one has ever questioned why yields are declining if the farmers are using fertilizer.

The truth is that more than 70 percent of fertilizer in the country is counterfeit. Even government officials cannot explain how or who imports such fertilizer.

In the past few years farmers have lost their entire crop as a result of maize lethal necrosis, a seed-borne disease that may have entered the country due to regulatory failure. The liberalised seed market must be subjected to a strict regulatory environment if we want to realise food security.

Other factors that impact food security include the high percentage of food that goes to waste due to poor storage and non-scientific methods of food preparation; cultural practices that undermine the health of the people; farming methods; consumption patterns; and poor logistics in moving food from areas of surplus to deficient regions.

Food Storage Options

Between harvest and the dining table, more than 50 percent of food goes to waste. Much of this can be eliminated. The Ministry of Agriculture has been talking about hermetic storage bags (used for food preservation to reduce post-harvest losses) but the fear persists of unscrupulous businessmen flooding the market with counterfeits.

There are also galvanized small grain storage bins that can provide secure storage for medium enterprises. Essentially, the technologies to eliminate as much as 30 percent of waste exist. Other types of food waste results from failure to align food preparation and consumption. Tons of unwanted food ends up in waste dumps while millions of people go hungry.

Many people cook more food than they consume due to cultural beliefs that if every bit of food is consumed you must be selfish. This causes even the poor to waste large quantities of food even when hunger looms. Before the 1950s, land use in Africa was communal. As independence approached, many African countries adopted new land-use methods

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of individual ownership.

Taxes On Unused Land

Today, it is not uncommon to find large, unused tracts of arable land owned by a single individual. This anomaly must be corrected through land-use policy interventions like paying taxes for not-utilisation of land. At the same time, a lot of land lies idle and unused in places like Nakuru, Uasin Gishu, Laikipia and Trans Nzoia because people who hold titles to it cannot access it for purposes of farming owing to hostilities from communities claiming it as their ancestral land, gazing lands or forest lands.

This poses a serious threat to food security. Counties where this is happening and the national government should perhaps be made to pay annual rent at market rates to the titleholders for failing to facilitate the use of the land. This process should start with a census of such inaccessible land. Traditional methods of farming can no longer support the growing population. Adoption of new methods is

imperative and for this to work, the mind-set on large-scale production must become part of the farmer's DNA.

Commodity Exchanges

This cannot happen without sustained training programmes through incubation and financial support to undertake initial projects in productive areas as well as an intensified programme to use irrigation methods to expand farming into arid and semi-arid lands.

Other programmes like dairy and beef production are essential especially in areas with a high incidence of children with stunted growth.

Perhaps the weakest link in our food security is the distribution from low to high-surplus areas. Through incentives, the government must encourage the private sector to develop commodities exchanges to help with the logistics of food to reach those who need it throughout the country.

Already there are start-ups building supply chain networks but they may need policy support to distribute food to sparsely populated areas that may not be attractive to invest in. Lastly, there is a need to encourage people through education to diversify their foods. In most cases when people say there is hunger, they mean there isn't enough maize.

Other Food Options

Yet, at the same time, there are potatoes, rice and other foods that are not culturally considered as "food". Making Kenya food-secure does not need to be a complicated affair with billions of resources being deployed. We simply need prudent policy changes, political will and tax incentives to stimulate the agricultural sector. Parliament should by now be crafting new legislation, especially on land use, stiffer penalties for those manipulating the sector for their own benefit.

With proper policy measures, strict standards, assisting farmers to reduce post-harvest losses, irrigation (arid and semi-arid lands), adjusting cultural practices, improving farming methods, we can attain food security.

The writer is Kenya's ambassador to Belgium, Mission to the EU,OACPS and World customs Organisation

Distribution remains a persistent challenge when it comes to food access in Kenya. There has been systemic market failure in moving food from surplus regions to deficit regions. Economic theory predicts that in a functioning market system, incentives through higher price will be offered to attract suppliers from surplus areas.

H.E Dr. William Ruto Flagging off relief food to drought stricken areas.

Why Kenyans are going hungry months after a bumper maize crop

More than 1 million people are in need of food aid in Kenya's arid areas – and yet the country produced a bumper harvest only months ago. Tim Njagi Njeru explains why this is the case.

Why do Kenyans go hungry after bumper crop of staple maize harvests?
Distribution remains a persistent challenge when it comes to food access in Kenya. There has been systemic market failure in moving food from surplus regions to deficit regions. Economic theory predicts that in a functioning market system, incentives through higher price will be offered to attract suppliers from surplus areas.

In Kenya's case, the expectation is that the price of food in deficit areas will be higher, attracting traders who buy from producers in surplus areas to sell in the deficit areas. This goes on until there is equilibrium – the demand in the deficit areas is met and prices return to equilibrium.

But the market system consistently fails to deliver this outcome in Kenya. And deficit areas remain under supplied. In addition, the government fails to correct this market failure, in spite of an effective early warning system coordinated by the National Drought Management Authority.

The authority releases seasonal assessments and monthly reports on the drought and famine hot spots, including the current scenario facing the country.

Reports of severe hunger amid plenty highlight the fact that there's coordination failure in government. The government's failure to coordinate the efforts of various actors at both the national and county levels is what has led to this situation.

What should happen to ensure food flows from production to deficit areas?
The National Drought Management Authority releases early warning reports for famine prone areas. Other important reports, such as those by the Famine Early Warning Systems Network, provide forecasts not only for Kenya but for the region.

But, as is often the case in Kenya, key policy decisions don't follow.

The media started reporting the current famine in early enough. Reports escalated, after which there was an immediate response by the government. This response must obviously be welcomed. But why is the government always reactive? Back

in August last year the drought assessment reports was warning that about food shortages based on the Kenya Meteorological Department's warning about rain shortfalls.

In addition, reports by the regional early warning system were also available.

All these reports should have prompted measures to improve surveillance in the hot spot areas and action planning should have started early. None of this has happened.

It's not too late. But the government needs to act quickly to identify citizens' food needs in areas affected by the drought. It needs to put measures in place to ensure access of food. Already, the National government has flagged relief food to be distributed in the affected areas. But that might not be enough. The government must work out what's still needed until the famine stress is over, then plan to make food available in these areas.

> "Although food security is a national government function, county governments should play their part. County governments are, after all, the "first responders" when it comes to food security."

Sacks of Maize

Effective delivery systems don't imply that the government should start sending trucks loaded with food to affected areas. Innovative approaches should be used. For instance, the market is likely to respond faster than the government. The government could kick start a virtuous cycle by providing cash transfers to affected citizens, enabling them to buy food. This in turn would lead to farmers who have maize in their stores to start selling to suppliers attracted to delivering food in famine areas.

Why is this not being done and who is responsible for any failures?

There is a lack of coordination and clear lack of implementation of the strategies for ending drought emergencies. Although food security is a national government function, county governments should play their part. County governments are, after all, the "first responders" when it comes to food security.

For this to happen, data on food production and consumption must first be updated. The availability of data and evidence is critical for decision making. But the capacity of county governments to collect reliable and accurate data is weak. And the capacity at the country's meteorological centre needs to be strengthened. Without proper data neither the national nor the county governments can plan for famine and drought.

Secondly, policy makers should already be getting into gear to take action in areas likely to be affected by the fact that forecasts for the long rains season, expected from March to May, have been revised to suggest that some areas won't be getting adequate rainfall.

This would ensure that national and county governments don't land up struggling to deal with an emergency. By preparing adequately they can avoid

Kenya's maize price has doubled in a year

The elections in August offered Kenyans a temporary distraction from some of the challenges the country is facing. At the top of these challenges is food insecurity. In 2022, the country has experienced higher food prices than ever before. Among the commodities that have seen high price increases is maize. This staple food has doubled in price in a year.

Food price inflation, although the result of a "perfect storm", will be high on the agenda for the new administration, which has promised to develop a lasting solution.

The current food inflation is a result of a combination of factors. First, the COVID-19 pandemic affected both production of food and inputs for production. Coupled with supply chain challenges, prices of inputs on global markets started to rise during the last quarter of 2021.

Second, Kenya is experiencing one of the worst droughts registered in the past four decades. The La Niña weather phenomenon has hit the central, eastern and northern regions of the country, leaving about 4.3 million Kenyans in need of food assistance as of August 2022.

Third, the Russian war in Ukraine affected supply not only of grains, but also of key inputs such as fertiliser.

These shocks occurred simultaneously. But long-standing issues in Kenya must be resolved anyway if the country is to be self-sufficient in staples, such as maize.

Preventing future crisis

There are six areas the incoming government should focus on:

Reduce the cost of production: In 2022, the cost of all inputs, including seed, fertiliser, agro-chemicals, hire of machinery and labour, increased. Simulations based on cost of production studies suggest that the cost of maize production will likely rise by an average of 60% for the 2022 main season. The cost of production is projected to be upwards of KSh4,000 or about US$40 for a 90kg bag, with a two-kilogram packet of flour retailing at an average of KSh220 (US$2.2). It is estimated that the annual per capita consumption of maize is 80 kg. This translates to about 200 grams daily. The average household, with four members

would require to spend about KSh600 per week (about US$6).

To maintain prices at affordable levels, farmers should aim to produce maize for less than KSh1,800 (US$18) per 90-kg bag. This would allow the producers to sell at around KSh2,300 (US$23). Market data suggests a wholesale price of KSh2,300 (US$23) per 90kg bag will translate to a retail price below KSh90 US$9) per 2kg. This would be a great outcome for the country: producers would get a profit while consumers could afford to buy an essential staple.

The key cost drivers in recent years have been the rental value of land and labour. Besides these, low yields result in high production costs. Therefore, by increasing maize productivity, farmers would likely register lower costs of production, but there is still a need to address the other cost drivers. This can be attained through policy.

Fix policy incoherence: Coherence in policy is easily attained when it's based on evidence. Decisions based on politics lead to incoherent policies. For example, a fertiliser subsidy came too late for the maize planting season this year and its design was criticised. And the maize flour subsidy announced in July was inefficient: everybody got the subsidised flour.

Combat climate change and build farmers' resilience: The government must invest in getting and sharing advance information about weather. This year, alerts about poor weather should have resulted in advisories for farmers about what to plant. Farmers also need a better understanding of crop insurance.

Reduce post-harvest losses: For maize, this has occurred mainly due to poor storage infrastructure, and poor handling and storage of grain. There are new laws to encourage private sector investments in solving the problems – they need to be finalised and put into action. Then farmers wouldn't have to sell crops at low prices straight after harvesting.

Invest in agricultural data systems: Once again, this must be done in cooperation with county governments, which are closer to farmers. Reliable and credible data will be useful for informing policies and interventions. It can alert the public sector to shocks such as low production. This was recommended in 2019 but the government is yet to implement most of the recommendations.

Address stagnation in productivity: Although in some years the country has registered increases in maize production, this has come primarily from area expansion rather than from productivity increases. There is a need to support county governments to revive extension and advisory systems. Robust systems make it clearer what farmers are purchasing with subsidies and how productivity is affected.

Ethiopian example

Kenya can benefit from the experience of other countries in the East Africa region. For example, Ethiopia has registered increased cereal productivity over the past two decades. It achieved this primarily because it revamped its extension systems and combined them with an inputs subsidy programme which delivered seeds and fertilisers to farmers. The strategy was to teach farmers about new technologies and enable them to get the inputs required to use new knowledge.

Why Every Drop of Water Counts in Feeding a Growing Population

Water is life. So we hear. But nowhere has this been aptly captured than in feeding a burgeoning world population. Globally there is an estimated 842 million hungry people meaning one in eight people in the world suffer from chronic hunger.

Serious concerns about how prepared the country is in feeding the growing population with the same, or even shrinking land space would be addressed have been raised. The idea is to ensure a smooth food system that allows uninterrupted processes from farm to fork.

With Kenya having two thirds of its land under arid and semi-arid zones, concerns on how to exploit these lands to keep the nation food secure in the wake of changing weather patterns and dwindling agricultural land has been rife.

Yet for hundreds of thousands of smallholder farmers in the country struggling to place food on their table and earn some form of livelihood, there is no second option even as that one drop of water to nourish those tender crops seems out of reach.

But any agribusiness behemoth world over knows better than just relying on the heavens especially for year round supply of food. And even as we toy with the idea of

Dr. Bimal Kantaria

making Kenya the breadbasket of the continent and ultimately the world, our modus operandi must go through a complete 360 turn around. Nowhere did farming that relies on the heavens even save a country from the yokes of hunger.

And it starts with our very own small farmers. Getting smart by utilizing small spaces of land to grow more, taking advantage of water sources and water harvesting techniques to save this all precious commodity for future use. It is possible and can be done. For the past few years, farmers have been awarded for emerging top in the National Farmers Award Scheme organized by Elgon Kenya Ltd and the Ministry of Agriculture. But what is striking is that a number come from areas considered infertile, with its people cast to endless hunger. But behind the heartbreaking media images of barren swathes of land and empty bowls, is the story of oases of hopes that has seen these farmers feed not just their families but their entire region. And they did it with so little; their resolve was to farm smart. And such efforts are the baby step to the country's resolve to be hunger free.

That is why government's renewed passion to open up millions of agricultural land for irrigation is a step in the right direction. Irrigation makes agriculture possible in areas previously unsuitable for intensive crop production. Irrigation transports water to crops to increase yield, keep crops cool under excessive heat conditions and prevent freezing. Yet even with this amazing concept less than 10 percent of Kenyan cropland is irrigated.

But talk of irrigation alone doesn't help. What exactly are we doing to empower especially the small holder farmers across the country understand the essence of economical water use? We must account for every water drop we use, to allow it translate to high yields and fed nation.

Drip irrigation one of the most promising irrigation ventures has been hailed world over for delivering maximum yields with minimum water. Such venture should be second gospel to our farmers. Then there is the affordability. With most small scale farmers owning small tracts of land, it makes sense to give them something equally small, manageable and pocket friendly. Drip irrigation kits like Elgon Kadogo drip kits have been testament to the fact that if we warm up farmers to affordable irrigation methods, we will break the myth of farming through irrigation among our farmers and eventually create a green nation.

The writer is a Director at Elgon Kenya Ltd.

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National Park East Gate Road, Off Mombasa Road
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The Evolutionary Context of Insecticide Resistance

From The National Geographic to The Wall Street Journal, popular media are fond of stories on how insects have ruled the Earth from the Dawn of Time, and how their rule will continue well into the distant future. Indeed, insects and their relatives, such as centipedes, springtails, mites, and spiders, were among the first organisms to colonize terrestrial habitats.

Since then, they have successfully survived all the major extinction events and, as a group, prosper in a wide variety of rather diverse environments. Unfortunately, quite commonly such a high adaptability represents a serious problem to humans.

Professional entomologist, find it borderline offensive that all-too-many people consider every insect to be a disgusting and vaguely dangerous creature that should be stepped on, smashed with a folded paper or, even worse, sprayed with insecticide from a bright and shiny aerosol can. In fact, most insects are highly beneficial. Without them, we would not have most fruits and vegetables in our daily diets (if you eat a cucumber, thank a pollinator), drowned in refuse, and could not have received a gift of real silk pajamas. Furthermore, there would be no honey to put in a cup of tea to combat a common cold contracted while volunteering for Read-a-Loud Day at a local children's library.

Having said that, many insect species are indeed pests. Not because they are evil or malicious, but because they happen to utilize the same resources – food, fiber, construction materials, or recreational facilities – as we do. This creates understandable tensions, and we are trying to use our highly evolved human brains to do something about it. Despite the size of our brains, however, we eventually settled on a single most common solution: to produce some poisons and use them to kill the little buggers as quickly as possible. Such an approach comes with a considerable environmental price tag attached, but it works. Until it doesn't.

Repeated applications of insecticides lead to resistance development in exposed insect populations. It is a typical selection process. With uncountable billions of insects out in the field, a few of them develop random mutations allowing to deal with insecticides in one way or another. Some of the resistant individuals get a capability to digest toxic compounds and break them down into harmless molecules. Others become able to pass poisons through their bodies without having them stuck to any internal tissues. Still others start avoiding exposure to toxic chemicals by changing their behaviors.

Without insecticides in the environment, such mutations usually come at a cost. Resistant mutants often have a shorter lifespan, lower reproductive success, and suffer high mortality. As a result, they are being outcompeted by their susceptible counterparts, and their numbers remain low. After an insecticide is applied, however, only resistant organisms can survive a toxic onslaught, while their susceptible competitors are removed from the population. Resistant survivors quickly build up in numbers and prosper, often to a great detriment to human well-being.

Insecticide resistance is a very serious problem in agriculture. For example, the potato beetle, an important pest of potatoes, tomatoes, and eggplant, has become resistant to at least 56 different chemicals. The diamondback moth, which is a real curse for growers of cabbage, broccoli, and related crops, can withstand a whopping 95 insecticidal compounds. Not every population is resistant to every chemical, but the number of failures still speaks for itself.

As frustrating as it is, insecticide resistance should not be much of a surprise to anyone familiar with the basic concepts of the theory of evolution. This point often escapes common discourse, but toxic environments are not limited to agricultural fields or faculty meetings. Herbivorous insects have been likely exposed to insecticides for about 420 million of years, which predates not just our species, but mammals in general. Back then, those insecticides originated from plants. Not from human-built chemical plants with smokestacks and loading docks like now, but from living, photosynthesizing plants.

Many insect-plant interactions, such as pollination or seed dispersal, are mutually beneficial to the parties involved. However, many insect species eat plants. In response, plants develop defenses against being eaten.

Synthesizing toxic chemicals is a very common approach to protection against herbivores. Many insecticidal compounds produced by plants affect their insect targets in similar ways to insecticidal compounds produced by humans: disrupt cell membranes, inhibit metabolism, suppress nutrient and ion transport, inhibit transduction of nerve impulses, and disrupt hormonal regulation. Some chemical groups of synthetic insecticides are even modeled after natural molecules. For example, pyrethroids are similar in structure to pyrehtrum produced by daisies, and neonicotinoids are similar to nicotine produced by tobacco.

Not surprisingly, exposure to plant toxins triggered the evolutionary process described above for synthetic insecticides: only resistant mutants survived and reproduced. Those mutants became capable of devouring previously protected host plants, except for a few mutant plants that produced a different toxin still effective against the mutant population of herbivores. Those mutant plants survived and reproduced, until a new mutation in the insect population rendered their defenses obsolete. And so on, and so forth.

Such a sequence of reciprocal changes is known as co-evolution, and it is likely to be responsible for a large portion of the diversity of life on Earth. It is also no different from the “pesticide treadmill” of insecticide/resistance/new insecticide/new resistance sequence of events that is taking place in agricultural pest management.

Even underlying biochemical mechanisms may have considerable similarities. In particular, a family of enzymes known as P450s is extremely important for detoxifying chemicals of both plant and human origin. Changes in the amount and structure of those enzymes have been shown to be instrumental both for adaptation to new host plants, as well as for resistance to a number of synthetic chemicals.

Insecticide resistance should be treated as a specific case of co-evolution, not as some kind of a new phenomenon unique to industrialized pest control. This is not a very comforting thought because pest control practitioners have to combat resistance mechanisms that are well entrenched over hundreds of millions of years of evolution.

However, our ability to continue overcoming pest problems depends on our ability to understand their evolutionary origins. While many plant species successfully adapted to withstand insect herbivory, more than a few went extinct since early Devonian. If we do not want to join the latter, we should be able to reconstruct evolutionary history, learn its lessons, and act accordingly.

The ABC of Cover Crops

By Ruth Vaughan

Cover crops are planted to cover the soil rather than for the sole purpose of being harvested. Commercial cropping and removal of crop residue leaves the soil surface bare until the next crop is planted. Bare soils are very fragile and prone to erosion, capping, heating, and degeneration. Bare soils cause floods and dust storms.

Planting cover crops to protect and improve the soils provides multiple benefits for our agroecosystems. Cover crops are the way forward for climate-smart regenerative agriculture.

The Many Benefits of Cover Crops

Reduces soil erosion and improves water infiltration

Cover crop canopies reduce the impact of raindrops and decrease the breakdown of the soil structure and soil aggregates, which greatly reduces soil erosion and runoff and improves water infiltration. Holding the topsoil in place reduces the risk of environmental pollution and contamination of water sources by nutrients, pesticides, and pathogens. Cover crops protect against wind erosion of the topsoil. Topsoil loss is a huge driver of soil fertility collapse in Sub-Saharan Africa.

Nitrogen production

Cover crops can be grown for nitrogen production and to prevent nitrogen loss. Reducing the cost and environmental impact of commercial nitrogen fertilisers. There is more incentive for this due to the high costs and low availability of fertilisers.

Makes phosphorous more available

Cover crops can be grown to release locked-up phosphorus. For example in very alkaline or calcitic soils, sunflowers, a highly mycorrhizal crop, will take up phosphorus and release it as available organic phosphorus to the following crop. Some cover crops are deep-rooted and bring nutrients up, making them more available for shallower rooted crops.

Promotes microbial diversity and activity

Cover crops promote microbial diversity and activity. They keep soils cooler protecting the microbes in the soil and reducing organic matter burn-off or nitrogen volatilization. The root exudes from cover crops feed the microbes and encourage soil aggregation. They produce different plant wastes that stimulate different microbes.

High quality animal or wildlife fodder

Cover crops can provide high-quality animal or wildlife fodder, and food for beneficial insects and pollinators.

Suppresses soil diseases, pests and nematodes

Cover crops provide a natural means of suppressing soil diseases, pests, and nematodes. Specific problems can be dealt with by selecting the right cover crop.

Helps control weeds

Cover crops help control weeds in different ways. They can suppress weeds by direct competition for nutrients, moisture, and light. Some can have an allelopathic effect on weeds. Crop waste can be used as a mulch. Cover crops can be planned so that different herbicides can be used on the field to target specific crops. (e.g., broadleaf cover crops allow the use of graminicides).

Reduces soil compaction

Cover crops can reduce soil compaction. In very wet seasons, cover crops reduce the deep soil moisture content, allowing machinery on the fields earlier in the season and reducing compaction of wet soils. Cover crops, with deep tap roots, planted when the soil is moist, and the compaction zones are softest can penetrate hard pans. The increased organic matter, structure, and aggregate stability that cover crops bring to soils improve the soil's ability to withstand heavy equipment, resulting in less sub-surface compaction.

Bioremediate specific soil problems

Cover crops can be planted to bioremediate specific soil problems. They can be used to decrease the pesticide residues or heavy metals in a field. Halophytes (salt lovers) can be used for land reclamation in salt-affected soils. Over time a well-planned cover crop regime will increase your soil organic matter levels, help sequester carbon, alleviate climate change, and improve the soil fertility, reducing reliance on chemical interventions and bringing good returns to the farmer. Improved water infiltration and moisture storage in the soil is a big plus for rain-fed crops.

Vetiver grass is drought and goat resistant, excellent for contouring. It's very deep-rooted and can be used as a "cut and carry" fodder. The roots have a delicious scented insecticidal essential oil that can bring in extra money!

Types of Cover Crops

Green manure crops

Green manure crops are grown to be incorporated into the soil when they are still green. The primary aim is to add organic matter. Fresh green material increases microbial abundance, can reduce soil pH and releases plant nutrients for subsequent crops. Leguminous green manure crops fix nitrogen, the amount of nitrogen available for the subsequent crop can be as high as 40-60% of the total nitrogen that was in the green manure crop.

Catch crop

A catch crop is a quick-growing crop sown between seasons to make use of temporary idleness of the soil or to compensate for the failure of the main crop. The catch crop scavenges the available nutrients in the soil, reducing nutrient loss and making them available for the following crop. It can be rapid growing vegetables such as radishes, onions, spinach, or quick grain crops cereals such as rye, millet, buckwheat, or an annual legume such as soya bean. These crops can be ploughed back into the soil to increase the soil's fertility.

Trap crop

Trap crops are planted to attract insect pests from a commercial crop. The pests

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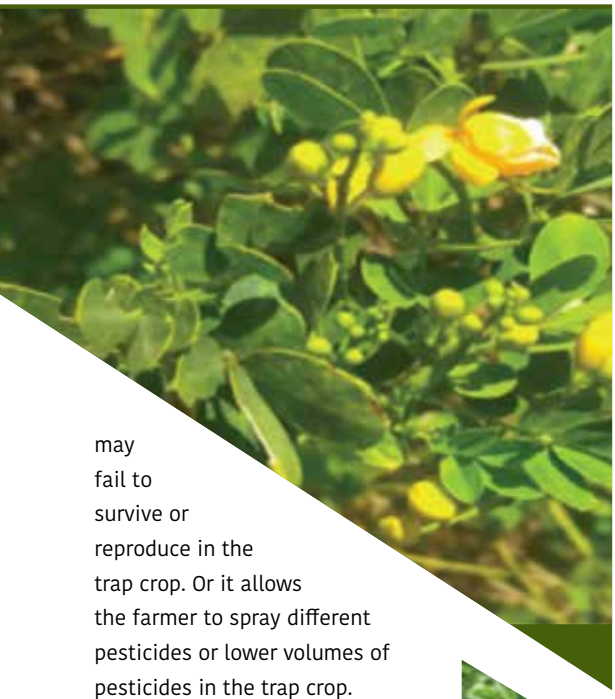


may fail to survive or reproduce in the trap crop. Or it allows the farmer to spray different pesticides or lower volumes of pesticides in the trap crop.

Break crop

Break crops are secondary crops grown to interrupt the repeated growing of cereals or maize. Canola is a beneficial break crop that brings financial returns.

Fodder crop

Fodder crops are planted to break cropping cycles. Common fodder crops are lucerne, Rhodes Grass, millet, Brachiara, Napier Grass, and sorghum.

Intercropping cover crops

Intercropping cover crops

Intercropping cover crops are grown inside the main crop planted at the same time or a short while after. A downside is that cover crops can compete with the main crop for light, moisture, and nutrients and can reduce the yield of the main crop. Intercropping is often practiced in regions with bimodal rainfall that have two maize crops a year.

Relay cropping

With relay cropping, the cover crop is planted inside the main crop but much later. The relay crop is left in the field when the main crop is harvested and is only incorporated into the soil during land preparation in the next planting season. This is mainly practiced in unimodal ainfall areas.

Fast-growing leguminous trees can bring huge amounts of biomass, have multiple uses and be more resilient to dry weather

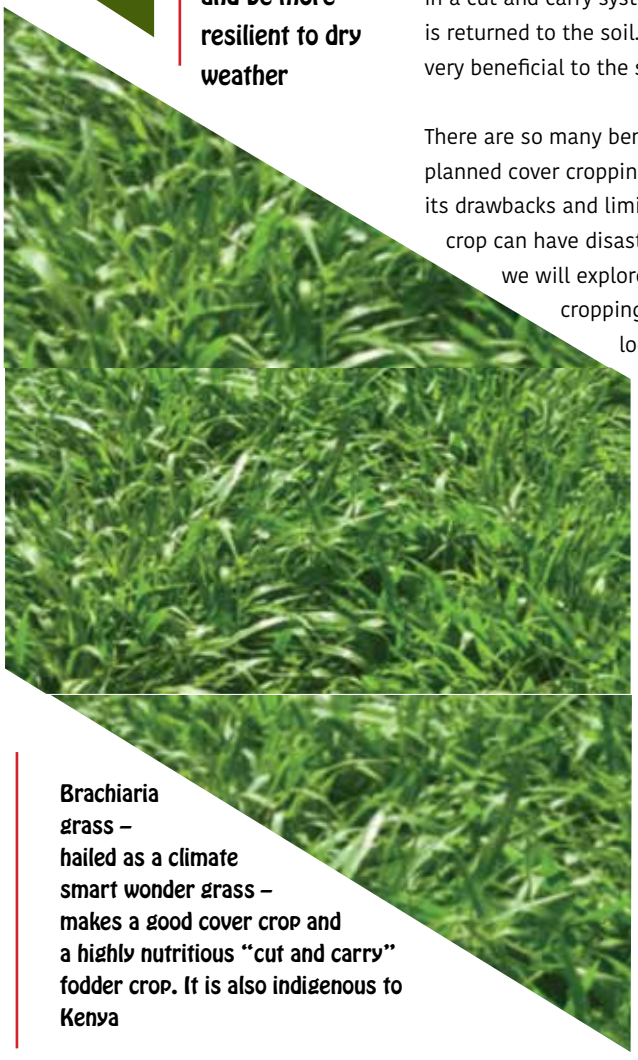
Rotational cover crops

Rotational cover crops are grown in rotation with the main crop. This is often practiced in bimodal rainfall areas where the second rainy season is unreliable or too short for the commercial crop. Quote from David Jones, the Agventure Agronomist, “like it or not we have two growing seasons, one grows a crop and the other one grows good weeds.”

Long-term cover cropping

Long-term cover cropping involves growing perennial fodder or agroforestry crops for several years before rotating to a new piece of land. The crop can be used in a cut and carry system and the manure produced is returned to the soil. Long-term fodder crops can be very beneficial to the soil structure.

There are so many benefits to be gained from properly planned cover cropping! But cover cropping can have its drawbacks and limitations. A badly planned cover crop can have disastrous effects. In the next issue, we will explore the Do’s and Don’ts of cover cropping, and investigate different local cover crops and their uses, including their Nitrogen and Carbon Contribution.



Brachiaria grass – hailed as a climate smart wonder grass – makes a good cover crop and a highly nutritious “cut and carry” fodder crop. It is also indigenous to Kenya

About Ruth

Ruth Vaughan is the Technical Advisory Services Manager at Crop Nutrition Laboratory Services Ltd. (CROPNUTS). Ruth is also a contributing author to Kenya’s leading horticulture magazines. Ruth is a great believer in soil health, organic matter, biochar and carbon sequestration as a way to alleviate climate change and increase food security. She loves visiting farmers and seeing all the different farming methods.

Choosing Wheat Varieties for That Big Crop

By David Jones

With malting barley plantings down considerably barley, many farmers will be growing extra acres of wheat to make up for the area lost. But what varieties should you grow to manage the risks of a big wheat area?

Robin

Still yields very well , and most importantly of all is consistent across a range of seasons and environments. My advice is to only plant this where you have adequate sprayer capacity to manage the Stem Rust risk. Besides that, Robin tends not to sprout, has quite stiff straw making it resistant to lodging, and perhaps most importantly of all millers buy it. Wren is still a good alternative to Robin, although perhaps not quite a high yielding.

Njoro 2

I have never seen a yield improvement from Njoro 2 over Robin of late. Now it has broken down to Stem Rust, its serious lodging weakness means that I would not see any reason to be growing this variety. Growing the right mix of variety is a key part of reducing risk and enjoying a successful harvest.

Eagle 10

A red wheat designed for drier environments, with faster maturity than the likes of Robin, Hawk and Korongo but lower yields. If you do grow it in some of the traditional barley growing areas (Mau Narok, Timau) the Yellow (Stripe) Rust needs to be watched closely and managed right the way through the crop.

Hawk

When everything is going in the crop's favour, this is the number 1 variety. Unfortunately it is one of the most inconsistent varieties I have ever encountered, anywhere! If you can manage the Stem Rust, in a wet season Hawk rewards with fantastic yields, and the relatively stiff straw means that tiller numbers can be pushed early without serious lodging risk. Beware low thousand grain weights in this variety – often 75kg per hectare of seed goes a long way, particularly if the seed crop experienced a dry, hard finish.

Korongo

Very good quality, reliable white grain wheat. Korongo's quality always presents a dilemma to agronomists, because in a dry season, all varieties can produce +80kg/ha specific weights. In a wetter season with an overcast grainfill period Korongo

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comes into its own, but it is also the first variety to lose its quality from bushel weight loss and sprouting if the harvest is delayed and wet. Yield is very consistent but 10-15% below the best Robin or Hawk, and Stem Rust and lodging need careful management.

Brambling

A white grain CIMMYT variety with very similar consistent yields and quality to Korongo. It is not much to look at and tends not to tiller aggressively, but Stem Rust resistance and stiff straw are major plus points over Korongo. Not yet released commercially. Fast maturity but Fusarium needs very careful management – NOT for a wet harvest!

Troy

A dry land, slower variety quality wheat that is most similar in its type to an Australian wheat. Stem Rust needs watching and yields are typically several percent below even Kwale and Korongo... unless, if planted early in a dry season this variety keeps its tillers and has shown more competitive yields. Seriously high Fusarium risk, the only variety to have failed me entirely in a wet harvest even with 1.0 l/ha of tebuconazole + prothioconazole applied at early flowering.

Kwale

The old established variety that refuses to die. Released in 1987, Kwale is one of the most consistent varieties in trials. Yields tend to be 10-15% below the best, but Stem Rust resistance is remarkable. Be aware of the very late maturity, and proteins can be on the low side.

Kasuko

Released from KALRO and CIMMYT, this high yielding, Stem Rust resistant red wheat is much anticipated. Do not expect yield to be a major improvement over Robin, and be ready to manage the Fusarium risk – I would still grow Robin or Hawk in a high Fusarium risk situation such as following maize. The upright growth habit and stiff straw do excite me however; there is a lot of work to do to understand this variety.

Strong Decision Making Is a Vital Part of Farming

A lot of the advice we give AS Agronomists is helping farmers to make sensible decisions. Often, this means dissuading clients from making impulsive changes to their cropping based on problems that they encountered in the immediate previous season. Avoiding a repeat of hard lessons or memories experienced in ONE season is a difficult thing to do, particularly where actions have clearly cost you dearly.

But not all seasons are the same, and this is will be particularly important after two very wet harvests for many people. In some areas this is a yearly reality, but certainly not normally in January and February! Choosing or abandoning crops or varieties based purely on the most recent season is clearly not sensible and can in turn cause more problems.

A typical example is farmers dropping white grain wheats which are more liable to sprouting. If you manage the risk with a sensible planting time and harvest date and not too large an area to harvest in one go, white wheats can provide some excellent quality bonuses.

Peas are also a crop that many will drop this year on the back of some very poor harvests. But newer varieties with greater Ascochyta resistance such as Bagoo will be a big improvement, and peas or beans

are essential on many soils for reducing nematode problems in the rotation – something that canola and chickpeas won't do.

Don't Second Guess Your Available Nitrogen

Looking through the trends of soil

Available Nitrogen over the last few seasons shows some very clear trends, and highlights why checking the nitrogen in the soil is crucial to making good topdressing decisions.

One particular clear example is when wheat is planted straight behind peas. Because peas are a relatively short crop reaching maturity in just 120-140 days, it is often a good opportunity to 'double crop' and plant wheat straight after them.

But as the case below shows, there is often far less nitrogen available in the soil straight after peas, suggesting that a lot of the Nitrogen is not released until it is mineralised in the fallow period.

We found on one soil type at Timau, Mt Kenya, that where a crop was planted after a fallow, which was preceded by a cereal or canola, we typically saw 109 – 156kg/ha of nitrogen available to that crop in the soil.

Healthy Wheat

Previous cropping	Available Nitrogen down to 60cm
Fallow after cereals or canola	109 – 156 kg/ha
Double cropped peas	95-105 kg/ha
Fallow after peas	129 – 179 kg/ha

Where a crop was planted after peas preceded by a fallow this rose to 129 – 179 kg/ha of nitrogen in the soil.

But plant a crop straight after peas without a fallow and Available nitrogen drops to just 95 – 105 kg/ha – potentially leaving a large shortfall and yield penalty if the crop is not top dressed adequately.

Nitrogen Deficiency in wheat

Food and Agriculture Cooperation Initiative Rice Symposium in Africa

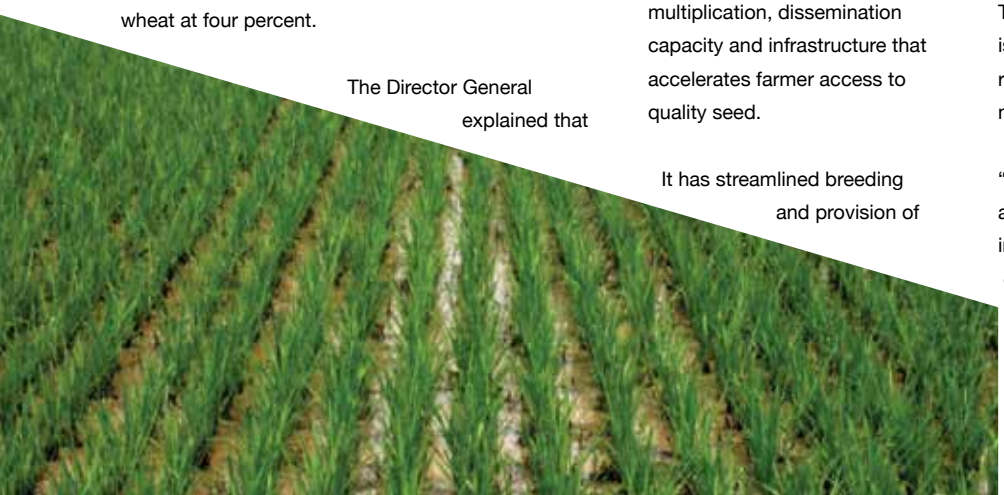
The First ever rice symposium organized by the Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI) was in Kenya, hosted by the Kenya Agricultural Livestock Research Organization (KALRO).

The symposium followed two days of evaluating the rice seed system in 21 member countries, an important activity in research.

Speaking during the opening session of the KAFACI Rice symposium at the KALRO headquarters, Nairobi, the organization's Director General Dr Eliud Kireger said the government of Kenya has identified rice as one of the three major food security crops that include maize and potatoes.

"The actors in the rice value chain, especially the contracted seed growers and merchants, are expected to benefit from the trickle effects of quality paddy production, resulting in improved socio-economic wellbeing," said Kireger.

As much as rice is the third most important crop in terms of food and nutritional security, Kireger however noted that in terms of annual consumption growth, it comes first at 12 per cent compared to maize at one per cent and wheat at four percent.



The Director General explained that local production of rice in 2008 stood at 80,000 metric tonnes, while the consumption was 350,000 metric tonnes, when the Coalition for African Rice Development (CARD) was formed to support countries double their rice production within 10 years.

Through interventions by development partners in collaborative projects like the KAFACI, the annual production has improved to 180,000 metric tons, while consumption continues to grow and now stands at 949,000 tonnes.

"As a country, the consumption of rice is expected to increase to 1,290,000 tons by 2030 due to population growth. In Sub Saharan Africa (SSA), rice consumption is expanding at 6 percent compared to 12 percent in Kenya," he said. The KAFACI project has been ongoing for three years and has helped build the seed multiplication, dissemination capacity and infrastructure that accelerates farmer access to quality seed.

It has streamlined breeding and provision of adequate quality seeds from some of the local cultivars that are dear to farmers but have not been cleaned to ensure true-to-type production.

Kireger said factors that contribute to low farm production include low yielding rice varieties, susceptibility to pests and disease as well as adverse weather and poor soil health. These will require concerted efforts by governments with support from development partners in order to realize high production per unit area.

He added that the KAFACI projects being implemented in over 20 African countries, including Kenya's National Rice Development Strategies (NRDS), developed and supported by CARD, were timely and have enabled countries to produce seeds for farmers helping them improve yields per unit area.

Yusuke Haneishi from CARD said following the 2008-2018 first phase of the project, there was significant progress made in rice production in Sub Saharan Africa resulting in 108 per cent achievement from 14 million tonnes in 2008 to 30.1 million metric tonnes in 2017.

The target for the second phase of CARD that is covering the year 2019 – 2030 is to increase rice production from 28 million tonnes to 56 million tonnes.

"The second phase will adopt the rice approach that is composed of resilience, industrialization, competitiveness and empowerment aspects, while maintaining the approaches of phase one which was value chain approach, capacity building and partnerships," said Haneishi.

Enhancing Water Management in Kenya's Dry Lands

By James Karuga

Land Restoration

Across sub-Saharan Africa, an integrated development programme is implementing land and water management interventions to enhance productivity and food security.

In the arid counties of Kitui, Machakos and Makueni in Kenya, over 30,900 smallholder farmers have adopted climate-smart farming methods to conserve water, restore degraded lands and fight food insecurity. Since 2014, a Dryland Development Programme (DryDev) has been working in the country, as well as in Burkina Faso, Ethiopia, Mali and Niger, to help farmers shift from traditional subsistence farming and reliance on emergency food aid, to sustainable rural development. The climate-smart land and water management practices introduced by the project include agroforestry, tree regeneration and the use of water harvesting ponds. Since the start of the project in Kenya, over 8,900 ha of land has been rehabilitated.

DryDev has trained farmers in how to increase tree cover through farmer-managed natural regeneration practices. Methods include pruning and thinning live indigenous tree stumps that still have some sprouts, to stimulate growth. As the indigenous trees regenerate, the land around the trees develops vegetation, and soil fertility is enhanced. Farmers are also intercropping nitrogen-fixing legume trees and plants like Gliricidia sepium and Faidherbia albida. The extensive root system of legume trees improves soil structure and ensures it doesn't harden in the heat, meaning rainwater is able to infiltrate the soil.

On his 0.3 ha piece of land, Urbanus Mutune from Machakos county has dug terraces to capture rain water and a large water harvesting pond with the capacity to hold around 500,000 l.itres.

Mutune uses the water harvested from his pond to irrigate his high-value tomato plants. "These days, without relying on rains, I can grow my crops according to market demand," says Mutune, who estimates that his yields have increased by over 80% since adopting the DryDev methods in 2014.

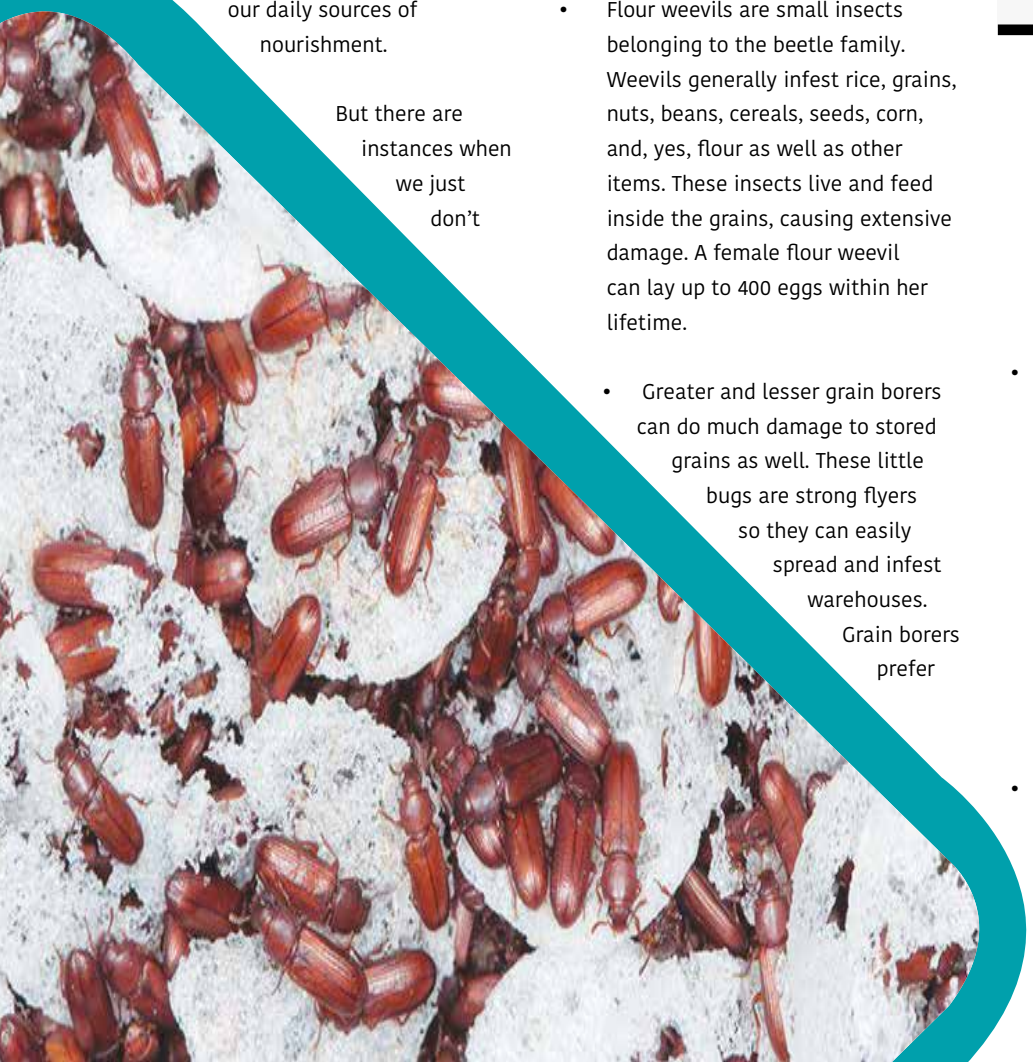
Rainwater harvesting and agroforestry practices have also changed the fortunes of Magdalene Kimeu from Machakos. Prior to the project, Kimeu was only able to grow traditional staples like maize and beans during the rainy season; now, she cultivates pawpaw fruits, collard greens, china cabbage, pepper, passion fruits and onions. The cultivation of pawpaw trees provides shade for her horticultural crops and reduces water evaporation following irrigation. "Neighbours now consult me on climate-smart farming and how they can be food secure like me," she Kimeu, who earns at least €13 per day from the sale of her horticultural produce and fruit trees.

5 Storage Pests to Keep Out of Your Warehouse

Whether you know it or not, you've probably eaten insects and bugs many times.These critters inevitably get mixed into our food, but we shouldn't be bothered by this. According to the US Food and Drug Administration (FDA) regulations, it's perfectly safe to have some insect parts mixed in while food processors are manufacturing our daily sources of nourishment.

But there are instances when we just don't want insects in our food, especially if those insects damage our food in storage. These insects are known as storage pests and can deliver substantial damage to stored food such as flour, grains, and maize.

So, here 5 insects you definitely want to keep out of your storage space:



- Flour weevils are small insects belonging to the beetle family. Weevils generally infest rice, grains, nuts, beans, cereals, seeds, corn, and, yes, flour as well as other items. These insects live and feed inside the grains, causing extensive damage. A female flour weevil can lay up to 400 eggs within her lifetime.

- Greater and lesser grain borers can do much damage to stored grains as well. These little bugs are strong flyers so they can easily spread and infest warehouses. Grain borers prefer wheat, millet, maize, and rice. Both larvae and adults can produce large amounts of waste, which contaminates the commodities and compromises safe

- Cowpea pod borers are known to severely damage crops by up to 70% to 80% in times of heavy infestations. Cowpea plants are considered to be one of the most important food sources in the savannas of Africa. This is why cowpea pod borers, also known as legume pod borers, are considered a major storage pest that should be eliminated.

- The Indian meal moth, also known as the weevil moth, pantry moth, flour moth or the grain moth, is another insect that grain handlers and processors should be wary of.

However, it's actually the larvae that damage the stored commodities, because interestingly, the adult Indian meal moth does not eat at all as an adult insect. This particular pantry moth is found all over the world and is a strong flyer as well.

Saw-toothed grain beetles also inflict damage on stored grains. These hardy insects are common around the world and can live up to 4 years. Females directly lay their eggs on the stored commodities, so both larvae and adults feed on the grains.

These insects, as well as other kinds, contribute to the damage that causes the loss of up to 1/3 of all produced food yearly. Farmers and food processors try to control insect infestations by using pesticides and fumigants in storage areas but find several challenges.

One challenge is the increasing pesticide resistance of these storage pests. Simply put, the said resistance of insects develops when insects pass on genetic characteristics that allow their offspring to become immune to a certain pesticide. This commonly occurs because of the prolonged use of one specific pesticide that the insects eventually get used to.

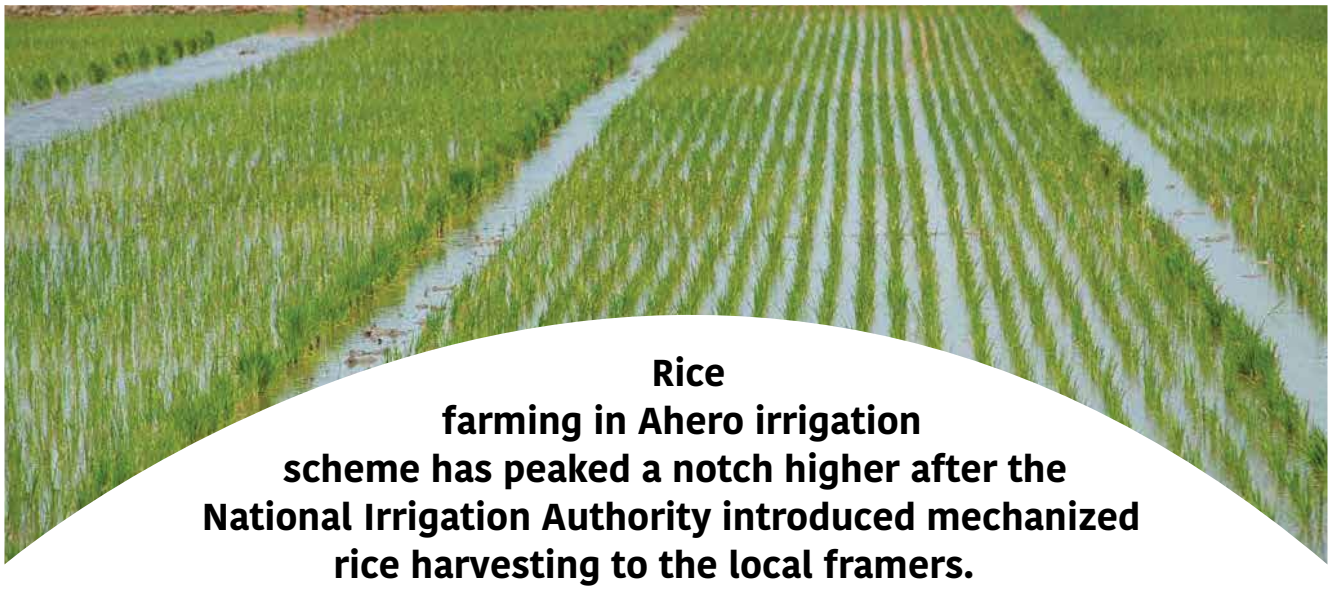
Using pesticides in stored commodities has another drawback. Usually, these chemicals only kill off adult and larval insects but leave eggs to hatch and develop into new adults. This renders treating the stored food with fumigants and pesticides useless because infestations will simply occur again.

Another challenge that food producers and manufacturers face is the hastened spread of storage pests due to increasing global temperatures. It's been observed that warmer temperatures can cause increased insect activity and even allowing these bugs to thrive in previously inhospitable areas.

Alternative solutions are currently being used to control insect infestations. One such solution is the use of hermetic storage, wherein a modified atmosphere is created to deprive oxygen needed by the insects. This is done by sealing off a storage container and ensuring a carbon dioxide-rich environment inside.

By using carbon dioxide, killing off storage pests is an easier and safer task. Because this is a natural gas, applying carbon dioxide inside hermetic storage is also considered as an organic pest control treatment.

Mechanization of Rice farming in Ahero



Rice farming in Ahero irrigation scheme has peaked a notch higher after the National Irrigation Authority introduced mechanized rice harvesting to the local framers.

Nyanza Regional Coordinator for the National Irrigation Authority (NIA,) John Tanui revealed that the introduction of the harvesters follows a study that revealed that farmers incur losses of up to 30 percent of their income during the harvesting season, which compelled them to introduce the rice harvesters, which has now completely revolutionized the farmers' earnings pushing them upwards.

"For the last four or five years we have been doing studies on the losses the framers incur in terms of post-harvest losses and we have realized that farmers lose up to 30 percent of their produce during the post-harvest stage and the percentage that is substantive money for the farmer," he said.

He said a farmer who is used to getting Sh100, 000 per acre used to lose up to Sh30,000 in harvesting which is enough for them to do production activities.

"We introduced combine harvesters and as we speak now, all the farmers in this region have mechanized rice harvesting," noted Tanui.

Tanui noted that the use of combined harvesters has increased rice production to 40 bags from 20 bags per acre previously.

The farmer also hailed the introduction of the combine harvester as having led to the harvesting of cleaner rice without many husks and impurities as opposed to the situation before.

The Coordinator has therefore urged the farmers to embrace use of the harvester to lessen their burden of harvesting and also make their rice more likable in the market.

Tanui also disclosed some of the plans NIA has in the pipeline for the rice farmers such as introducing the mechanical drying of rice to save on time and losses even as he revealed that the scheme has already acquired a rice trans planter to replace manual planting.

The Ahero rice farmers led by their Chairman, John Obiero, hailed the mechanized rice harvesting for sprucing their income and advised local farmers to embrace the technology.

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Tanzanian's Climate-smart Sorghum

- Farmers in Tanzania prefer sorghum varieties that are tolerant to environmental stresses are high yielding, early maturing with white grain colour and capable of fetching higher grain prices.
- Farmers are willing to pay the highest premium for tolerance to environmental stresses, amounting to an average of three times the willingness to pay for other traits.
- Demand for sorghum has increased rapidly over the years as it is widely used to produce clear (lager) beer and non-alcoholic drinks apart from its utilization for food purposes.
- The study has important implications for demand-driven variety development that could contribute to improving crop productivity and household welfare.

Against the backdrop of recurring adverse climatic and agronomic conditions, such as drought, disease, and pests in Africa, a study by researchers from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has established that environmental stress-tolerant sorghum varieties are most valued among Tanzanian farmers.

The results could contribute to improved crop productivity and household welfare. Sorghum is well-adapted to arid and semi-arid environments with limited rainfall and high temperatures, where other cereal crops such as maize cannot grow.

Its importance has risen following the prevailing threat of climate change and global warming because it is proven to provide a harvest even in bad years. While sorghum is used mostly for food purposes, its demand has grown rapidly in Tanzania over the past few years as it is widely used to produce clear (lager) beer, non-alcoholic drinks, and bioenergy drink production.

The study, led by Mequanint B Melesse, Cluster Leader – Technology Adoption and Impact Analysis, ICRISAT, published in the Journal of Crop Improvement, used a choice experiment design to evaluate farmers' preferences for traits of sorghum varieties in Tanzania.

The experiment involved six key sorghum attributes: yield, maturity, grain price, color, tolerance to environmental stresses (disease, pest and drought) and cost of seed to evaluate farmers' preferences.

The analysis relied on data collected between October – December 2019 from six regions – Dodoma, Singida, Shinyanga, Tabora, Songwe, and Mara. A multistage sampling design was employed to select sample households. A total of 1,301 sorghum farmers were interviewed to understand their preferences.

It was found that farmers strongly valued sorghum varieties that are high yielding and capable of fetching a high grain price, thereby enhancing their household income. "On average, farmers were willing to pay TSh 6,280 (about US$2.7) to move from a non-stress tolerant to a stress-tolerant seed variety. Farmers were willing to pay for tolerant varieties two times the amount they were willing to pay for an increase in grain yield of two tons/ha. A tolerant variety was valued about six times the value respondents attached to a change from the longest maturity to the shortest maturity variety," stated the study.

The study further showed that a tolerant variety was also valued four times higher than both the value farmers were willing to pay for changing a sorghum variety from one fetching 250 TSh/kg grain price, to one fetching 550 TSh/kg grain price, and from red/brown coloured grain to white. Sorghum covers about 0.8 million hectares of land annually, with average productivity of about 1,000 kg/ha in Tanzania. More than 70% of the respondents favoured a tolerant seed variety, higher grain prices and a shorter maturity period.

In addition, farmers also revealed strong preferences for early maturing sorghum varieties. "Early maturing varieties lower the cost of production with respect to input usage, overcome unpredictable weather patterns and allow multiple cycles of production per season, as well as help poor households to bridge lean seasonal consumption shocks," stated the study.

Inspiration from Kenya's Agriculture top technocrat **Professor Hamadi Iddi Boga**

Calm collected and sharp as a razor is a description that befits Professor Hamadi Boga, former Principal Secretary at The State Department of Crops Development and Agricultural Research, in Kenya's Ministry of Agriculture, Livestock, Fisheries and Cooperatives. Behind this demeanor resides a wealth of knowledge and experience that the country continues to benefit from.

In an exclusive interview at his office, we engaged the professor of microbiology and microbial ecology in a candid discussion to unravel the man who had been tasked with providing solutions to the country's food security agenda.

"Efforts to modernize the agriculture sector have to deal with the smallholder nature of the African farmer, and sub-optimal political good that is required to increase investment in the sector."

Briefly take us through your personal Background

I was born and raised in the coastal County of Kwale, and a first-born in a family of eight children, I attended both regular schooling and madrasa in my early years, eventually studying my way into university.

I am a husband and father of three daughters. I attended Mvindeni Primary School in Diani, Kwale County where I sat my certificate of primary education (CPE) and Voi Secondary School for my Kenya Certificate of Secondary Education (KCSE). I was then admitted to Kenyatta High School, Taita where I sat my Kenya Advanced Certificate of Education (KACE), paving way for my admission to Kenyatta University for a bachelor's degree in Botany and Zoology. I proceeded to undertake my MSc in Microbiology at Kenyatta University, and undertook my doctorate at the renowned Universität Konstanz, Germany, in Microbiology/ Microbial Ecology.

My first love was medicine, a desire borne from my interaction with my father who was a public health technician. I however failed to make the cut off for the course and that is how I got admitted for Botany and Zoology an area I became fond of due to its fundamental relevance to ecosystems. I don't regret not having done medicine and everything that I became is because of the opportunities that biology has brought me.

How will you be remembered in the Academic Sphere?

My skills have played a huge role in nurturing and mentoring numerous philosophy (PhD) and Masters of Science (MSc) students, who today work in institutions of high repute in Europe, the Gulf region and America.

I have certainly left a mark in the academic sphere, where I rose through several ranks, including holding the position of chair of the botany department and dean of the faculty of science at the Jomo Kenyatta University of Agriculture and Technology (JKUAT).

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I later took on the herculean task of setting up the Taita Taveta University, a first of its kind in Coastal Kenya, offering unique courses such as mining and environmental engineering that brought forth the Centre of Excellence for Mining and Mineral Processing Engineering (CEMEREM). While there, I grew the university from a no-student population to over 5000 students by 2018, when I departed, following my appointment by His Excellency President Uhuru Kenyatta to the position of Principal Secretary.

I still found time to supervise Philosophy Degree (PhD) students while serving as a PS. I am torn between going back to teach at the university, serving at regional or global level.

You have been the chief Technocrat at the Ministry of Agriculture, how will you be remembered

I have left with satisfaction, having helped government tick off major milestones in the agriculture sector but wishing there was time to do more. I have fast-tracked policies and strategies that are key for agricultural sector growth in the country. Key amongst these is the completion of the agriculture sector transformation and growth strategy (ASTGS), a ten-year plan that aims to accelerate end hunger. The ambition, forward-thinking, practicality and transformative nature of the strategy provides a glimpse to the meticulousness and detail of a man who views his professorship as a path to solving society's challenges.

My footprint is also evident in various reform initiatives, notably, streamlining the national strategic food reserve through the warehouse receipting system to improve transparency and accountability, especially in the maize sector.

Through the transformed fertilizer subsidy program, registered famers are now receiving 40 percent of agri-input support from government through the e-voucher system. These include fertilizer, seed, and grain storage bags. Farmers have been receiving inputs since 2015 when the programme was introduced. But being tech savvy myself, I championed digitization in the agriculture ministry to improve efficiency and accelerate growth, with government remaining on course to review its policies to integrate ICT tools including in extension functions.

I have championed numerous programs targeting modernization of agriculture including the Kenya Climate Smart Agriculture Program that is bringing climate smart technologies closer to farmers.

What should be done to modernize Agriculture in the country?

I am brutally honest that efforts to modernize the agriculture sector have to deal with the smallholder nature of the African farmer, and sub-optimal political good that is required to increase investment in the sector.

The civil society and sections of government are a major stumbling blocks in the application of biotechnology in

"I have championed numerous programs targeting modernization of agriculture including the Kenya Climate Smart Agriculture Program that is bringing climate smart technologies closer to farmers."

Professor Hamadi Iddi Boga

agriculture, as they advance arguments against biotechnology tools that lack scientific merit.

Discuss Agricultural research in the country.

I have succeeded in reviving the national agriculture research systems policy, opening up opportunities for engagement and growth. I however caution on the scattered budgetary allocations in various agencies such as National Commission for Science Technology and Innovation (NACOSTI), National Research Fund (NRF), Kenya Agricultural and Livestock Research Organization (KALRO), that threaten to reverse gains.

Worth noting is that agricultural research in Kenya operates on a budgetary research allocation that is less than half of the recommended 2 percent, and heavy supplementation comes from development partners such as the EU, USAID, UN agencies, AGRA and BMGF. I however remain cautiously optimistic that my efforts to rally more funding from treasury will bear fruit.

The future of the country is on the youth and women. What have you done to boost their participation?

The agriculture ministry is vibrant with several programs targeting women and youth, borne from policy reforms that target financial inclusion, access to land ownership, and changing attitudes towards agriculture by youth.

Particularly, we have programs such as the Enable-youth program supported by the African Development Bank (AfDB), exchange programs in partnership with Israel, and the revival of 4K clubs, all triggered by the ministry's youth and agribusiness strategy.

Who has been your role model pushing you to your current achievements?

With all the feathers sitting unfettered on my hat, I acknowledge key persons that have served as motivation at different phases of my career. My father remains one of those, for instilling the ethos of hard work.

I appreciate Professor Mabel Imbuga, former Vice Chancellor at JKUAT who was instrumental in my academic achievements. I also admire Dr Agnes Kalibata for stimulating global conversations in food systems, and I look forward to doing the same.

Do you still have time for community service?

Despite all the responsibilities, I still serve my call for community service. In addition to being a patron of several community development initiatives, I chair and am a member of numerous high school boards in the coastal region. On a broader scale, I serve in several boards that target agricultural transformation in the African continent. These include the African Agricultural technology Foundation (AATF), ICIPE and the World Agroforestry Centre (ICRAF).

Recently, you tried you lack in politics without success, what future plans do you have?

As stated earlier I am open to go back to teaching, serving in the regional, country or global arena. I also do not rule getting back into politics in future.

Edited version of the original interview with PanAfrican Agriculture.

Weed Control in Maize Farming

Herbicides in the past were highly effective, cheap and easy to use. But reliance on herbicides alone has contributed to the widespread herbicide resistance problems that we are seeing today. If you look at the problem simply, herbicide resistance is nature's way of telling us herbicides alone are not sustainable and introducing more diverse weed control methods is required to disrupt the weed's life cycle. Weed identification is the key to an effective maize weed management program. Incorrect identification can mean the difference between profit and loss. Although a weed's life cycle, including its method(s) of reproduction, is the most important identifying characteristic, it is sometimes necessary to know the exact species before selecting weed management measures.

Maize growers should make a weed inventory to aid in the selection of weed control programs. By tailoring control programs to fit the problems in each field. Growers can minimize weed control costs while maximizing yields and profits. An inventory can be made by scouting fields two or three times during the year and recording the types (such as broadleaf annuals or annual grasses) of weeds present in each field.

The first observation should be made by the time maize is 3 or 4 inches tall. These early-season observations reveal how effective preplant or preemergence herbicides used and suggest the possible need for cultivation or for postemergence herbicide applications.

A second look at the fields is before the maize is waist high and can provide information on the overall effectiveness of weed control practices and provide clues on how the program might be adjusted in future years. This also is a good time to record the types and numbers of weeds present and to map the location of special problem areas in the field. Additional notes on weed types and numbers can be taken at harvest to complete the weed inventory.

Weed Management Methods

Although herbicides can provide effective weed management, maize growers should not depend on herbicides alone. Growers should use good cultural practices so the maize is competitive with any weeds and should integrate chemical control programs with cultivation, especially with difficult-to-control weeds or when weather conditions reduce herbicide effectiveness.

The first step in cultural weed control is the selection of a seed variety that has adapted to local growing conditions. Timely planting along with proper fitting in tilled situations or proper adjustment of no-tillage planters ensures rapid germination and a competitive advantage for the maize.

Another cultural practice that favors rapid establishment of maize is proper band application of fertilizer at planting. All primary (plowing) and secondary (fitting) tillage operations help provide a weed-free seedbed. Cultivation of row crops is an effective way to control annual weeds between maize rows.

Band application of herbicides over the row at planting, combined with one or two cultivations, provides good control of annual weeds. Although rotary hoes effectively destroy weed seedlings in small maize, a row cultivator adjusted to minimize pruning of maize roots should be used after maize is 5 or 6 inches tall. Creeping perennials are not adequately controlled by one or two cultivations.

These weeds regrow from rhizomes (underground stems) following cultivation and are controlled with tillage only if the operations are repeated over long periods. Biennial and simple perennial weeds do not persist in fields that are plowed but can be a problem in reduced and zone/no-tillage fields.

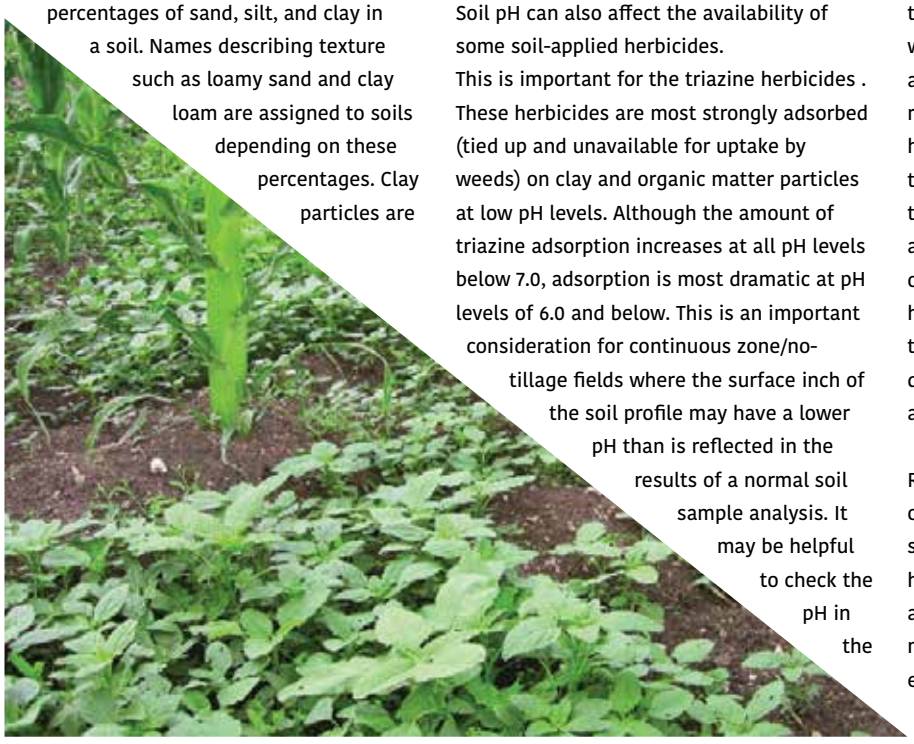
A variety of herbicides are available for preplant, preemergence, and/or postemergence weed control in maize. These herbicides vary in their effectiveness in controlling different weeds and in the length of time they remain active in the soil. Some maize herbicides can carry over to affect triazine-sensitive rotational crops such as legumes, small grains, and soybeans. Knowledge of the weeds present, herbicide effectiveness, and rotational plans should be considered when selecting herbicides. Cost of chemical weed control dictates that herbicides be applied when they will provide maximum return. Label guidelines for the timing of herbicide applications

Soil properties that affect the availability and activity of soil-applied herbicides include soil texture, organic matter level, and pH. All should be considered when determining herbicide rates.

are based on research and are geared for maximum weed control and minimum crop injury.

Factors Affecting Soil-Applied Herbicides
To be effective, soil-applied herbicides must be available for uptake by the roots and/or shoots of germinating weed seedlings. This means that they must be dissolved or suspended in the soil solution. Soil properties that affect the availability and activity of soil-applied herbicides include soil texture, organic matter level, and pH. All should be considered when determining herbicide rates.

Soil texture is determined by the relative percentages of sand, silt, and clay in a soil. Names describing texture such as loamy sand and clay loam are assigned to soils depending on these percentages. Clay particles are negatively charged and have a large surface area. As a result, soils high in clay content (heavy soils) have the capacity to adsorb or tie up herbicides and generally require higher herbicide rates than coarse-textured or light soils.



Organic matter content also affects adsorptive capacity of soils. Although un-decomposed plant and animal residues can influence herbicide performance, the well-decayed, fine organic matter particles known as humus are of greatest importance. Like clay particles, humus particles are negatively charged but exhibit an even greater capacity to adsorb or tie up herbicides than clay. Consequently, herbicide rates also have to be adjusted to the soil organic matter level.

Rates for soil-applied herbicides are moatly based on for medium-textured (loam) soils with organic matter levels of 3 to 4 percent. Fine-tuning the rates for other soils can be done by consulting the herbicide label for different soil textures and for varying organic matter levels.

Soil pH can also affect the availability of some soil-applied herbicides.
This is important for the triazine herbicides . These herbicides are most strongly adsorbed (tied up and unavailable for uptake by weeds) on clay and organic matter particles at low pH levels. Although the amount of triazine adsorption increases at all pH levels below 7.0, adsorption is most dramatic at pH levels of 6.0 and below. This is an important consideration for continuous zone/no-tillage fields where the surface inch of the soil profile may have a lower pH than is reflected in the results of a normal soil sample analysis. It may be helpful to check the pH in the top inch of the soil profile with a soil pH kit in fields that have been in zone/no-tillage for extended periods.

Soil pH also affects availability of some herbicides. These herbicides should not be applied to areas where soil pH is greater than 7.8 as this may result in unacceptable crop injury. In addition, soil applications of these herbicides should not be made to soils with more than 5% organic matter if soil pH is less than 5.9 as reduced weed control will result.

Herbicide Resistance Management
Herbicide resistant biotypes are common. Populations of these weeds were originally controlled with one or more of the herbicides at normal use rates. However, shifts to weed populations dominated by the resistant strains have occurred in many locales. These resistant strains are not controlled with extremely high herbicides use rates. In addition, there is cross-resistance among the different herbicides used in maize.

This situation has prompted refinements in the control guidelines for annual broadleaf weeds in maize. Herbicides have played, and will continue to play, an important role in maize weed control programs; however, effective control programs for these herbicide-resistant strains will involve the use of crop rotation and cultivation along with herbicide rotation and/or use of herbicide combinations that include herbicides with different sites of action (how they affect weeds). These practices will also delay development of weed populations that are resistant to the herbicide.

Rotating herbicides with different sites of action and the use of tank mixes or sequential applications that involve herbicides with different sites of action are key elements in herbicide resistance management plans. To do this most effectively, everyone involved in decisions about weed management must have site of action classification for herbicides readily available. HRAC has approved a numbering system to classify herbicides by their site of action. In this system, a group number is given to all herbicides with the same site of action. To further efforts in management of existing herbicide-resistant weed populations and to delay or avoid development of new herbicide-resistant weed populations, these “GROUP NUMBERS” are included in the “Chemical weed control tables” in each crop section of this guide.

Kenya's agricultural struggle and how youth are the promise of rebirth

The National Youth in Agribusiness Strategy (2018-2022) by the ministry of agriculture was launched with an aim of providing new opportunities for youth in agriculture and its value chains.

By Jane Muia

Kenya's agricultural sector has long been in decline, and the country's youth are bearing the brunt of the consequences. Unemployment is high, and those who are lucky enough to find work often earn less than they need to get by. The situation is particularly dire in rural areas, where most of Kenya's farmers live.

The agricultural sector plays a vital role in Kenya's economy. It is the country's largest source of employment, contributing approximately 33 percent of the Country's Gross Domestic Product (GDP). The sector also plays a key role in Africa as a whole.

Kenya is the continent's leading producer of tea and among the top coffee-producing countries in the continent. The country is also a major producer of maize, wheat, rice, sorghum, and millet.

The decline of Kenyan agriculture is due to a variety of factors, including droughts, poor infrastructure, and limited access to markets. In 2020, the widespread flooding damaged cropland and increased post-harvest losses. Also, desert locust infestations destroyed about 175,000 hectares of crop and pastureland. This affected the livelihoods of nearly 164,000 households.

The biggest challenge facing the sector is a lack of investment. Agricultural productivity has been stagnant for years, and the government has not been investing enough in the sector to make it competitive.

However, there is hope for Kenya's agricultural sector. The country's youth are increasingly interested in farming and are using innovative methods to revive the sector. For example, many young farmers are using social media to market their products and connect with buyers. In addition, they are using technology to improve production. For example, some farmers are using drones to map their fields and identify areas that need attention.

Such innovations are highly essential considering agriculture is a significant source of livelihood and income for many Kenyan households. The National Youth in Agribusiness Strategy (2018-2022) by the ministry of agriculture was launched with an aim of providing new opportunities for youth in agriculture and its value chains.

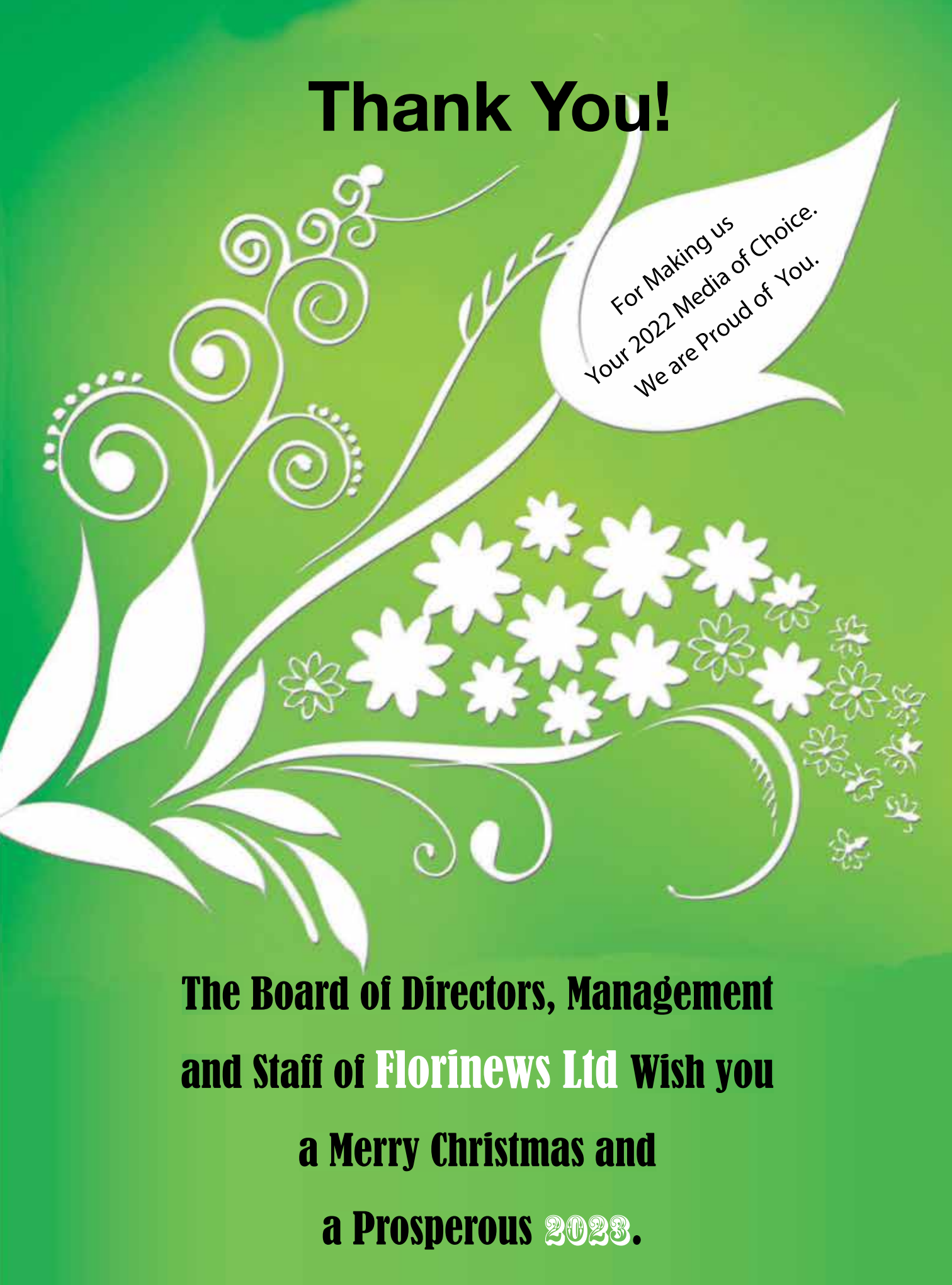
"We'll only move agriculture to the next level if we adopt new technologies and only the youth can drive adoption of these technologies," former agriculture cs Mwangi Kiunjuri said.

As a result of the program young people are using innovative approaches to farming, such as conservation agriculture, which is a more sustainable way of farming that can help to improve yields. They are also working on initiatives to connect small-scale farmers to markets so that they can sell their products at a fair price.

The youth are also playing a key role in spreading awareness about the importance of agriculture and the challenges facing the sector. They are using social media and other platforms to reach out to other young people and share information about the sector.

The youth are the future of Kenyan agriculture, and they have the potential to turn the sector around. With their energy, creativity, and passion, they can make a real difference in reviving the agricultural sector and making it more prosperous.

Thank You!



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