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July - September 2022

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How to Prevent Food From Becoming a Weapon of War

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TABLE OF CONTENTS

Editorial

Disease risk

Growers need to implement disease management strategies for every season, even though disease pressure is low at times. This includes: selecting the most disease resistant varieties possible, avoiding growing cereals in paddocks with high soil or stubble borne disease loads, and planning for the timely application of fungicides if required.

History tells us that disease pressure can be high in seasons following drought if conditions are conducive. It is therefore important to implement appropriate disease management strategies and be ready anytime.

This is due to the occurrence of conditions favourable for disease development any season. If varieties susceptible to some diseases are grown then a suitable management plan must be implemented.

Some diseases will need to be managed, due to carryover of inoculum on stubble from previous crops as a result of reduced stubble breakdown during the season. If diseased stubble is present then resistant crops/varieties should be selected where possible.

Masila Kanyingi
Editor

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How to Prevent Food From Becoming a Weapon of War

Hunger recognizes neither borders nor flags, and the global community must use every resource at its disposal to prevent food from becoming a weapon of war.

Mr. Marco Ferroni

By Marco Ferroni

Just as Europe is now counting the cost of relying on imported fossil fuels, the crisis brings into stark relief the world's reliance on limited sources of a critical staple food. With gas supplies already being weaponized, the potential remains for global food security to be held hostage in the conflict, with wheat a bargaining chip for the lives of millions.

Wheat prices have been classed as highly volatile , spiking in the wake of Russia's invasion of Ukraine. But in a commodity market that trades in futures — which surged by 50 percent since the war began — the full impact is yet to be felt, with Ukraine's next wheat harvest due from June.

The ripples are growing. Wheat consumption among the urban poor in import-dependent Sudan, a country already ranked as having "serious" food security issues, has dropped by 5 percent. And, Egypt, the world's largest importer of wheat, along with the rest of the Middle East and North Africa (MENA) region, has seen rising prices and insufficient supply.

Food must be protected and prioritized as a human right. With only weeks before the next harvest, the world, and in particular the global South, must act quickly to mitigate the threat to global food security. Policymakers need to take urgent, evidence-based action to prevent the looming crisis from spreading around the world.

At the same time, they must also make the right decisions for


Wheat Field

the longer term because this will not be the last crisis to destabilize global markets and food supplies. While the global community must step up to address the urgent humanitarian needs of those directly affected now, we must also be better prepared for future food shocks.

Investing in agricultural science, research and innovation will provide solutions and support evidence-based policy. Governments can draw upon existing research and lessons learned from previous food crises, both to make strategic decisions with the greatest likelihood of preventing food shortages, price hikes and hunger, as well as to build greater long-term resilience through more diverse and equitable food systems.

Schemes developed during the COVID-19 pandemic for the fast-tracked movement of food should be adapted to circumvent bottlenecks caused by the war. Targeted assistance and social protection must be enacted with an eye to the needs of particularly vulnerable groups. Local and international financing assistance for low-income countries with large import requirements should be assessed. Biofuel mandates diverting wheat and other crops to ethanol production must be suspended to help avert the global food systems crisis.

Farmers and policymakers in alternative breadbaskets around the world can support increased production of wheat but also other staple cereals to fill the supply gap. Over the past 10 years, India has adopted more than 100 new varieties of wheat and incorporated the cereal into mixed rice-wheat systems to diversify and improve production. But high fuel and fertilizer prices, exacerbated by the conflict, are hindering these intensification and diversification efforts.

Meanwhile, in the medium to longer-term, governments, funders, the private sector, and foundations should be prioritizing agricultural research and development to drive the shift toward a more sustainable, resilient — and therefore shock-proof — global food system.

We need innovations to improve the management of crops, livestock and fish systems and increase yields sustainably, using land, water and fertilizer wisely. Sustainably increasing production will in turn help to drive down the cost of food, making safe, nutritious diets more affordable and accessible.

One way to support this is to accelerate the breeding of new and improved varieties of key crops to increase production within the bounds of local ecosystems and

Oil Products displayed in a Kenyan Supermarket

resources. CGIAR scientists have already developed thousands of new crop varieties bred specifically for heat, drought and disease tolerance and enhanced nutritional qualities, helping to reduce infant mortality by one-third across the developing world and averting up to 6 million infant deaths each year. However, as the climate continues to change and food systems challenges compound, these breeds and characteristics need ongoing fine-tuning.

Agricultural research plays a critical role not only in transforming food systems but also in anticipating food needs and shortages, developing innovative solutions and working with governments to give countries the best possible chance of minimizing threats to food and nutrition security. As well as taking urgent and evidence-based action now, the world needs a systemic shift toward greater long-term resilience and stability in our food, land and water systems.

Marco Ferroni is chair of CGIAR System Board. CGIAR is the world's largest publicly funded agricultural research network. The views expressed are his own and not the view of The Cereals.

Disease Management in Cereal Crops

Typically, it's not possible to produce high yields in wheat and other cereal crops without paying attention to disease management. By following integrated pest management (IPM) practices, farmers have the opportunity to control and avoid many yield-robbing diseases.

Preplant Decisions Affect Diseases

It's important to keep in mind that by the time seed is in the ground, significant decisions about preplant agronomic practices can influence disease management. Each of these decisions work together to influence which diseases may develop, the severity of infection and how it will affect crop yield and grain test weight.

That's why spending time upfront to consider how to manage potential diseases can help enhance crop profitability. Another part of the disease management equation should include planning ahead for potential disease threats during the growing season.

Tillage/Crop Residue Management

Cultivation helps break down crop residue that harbours certain wheat diseases. Tillage is particularly helpful in geographies where continuous wheat is grown and can help reduce levels of some soil borne and foliar diseases caused by fungi. To effectively diminish crop residue, several tillage passes may be needed to break it up and bury it.

Tillage does add fuel, labour and water conservation expenses and contributes to erosion; however, if farmers are planting into residue from soybeans, alfalfa, rye, oats or sunflower, tillage is not necessary. This is another benefit gained from crop rotation.

Nitrogen/Balanced Fertility

In areas where soft winter wheats are grown, balanced fertility may help control some diseases. Use lime to maintain a constant, optimum pH level in your soils. Over application of lime in the fall, however, can lead to excessive fall growth and contribute to infection and overwintering of pathogens, causing foliar disease.

It's also well known that excess nitrogen can promote powdery mildew, leaf rust and leaf blotch. Excessive nitrogen, similar to excessive seeding rates, can create stands so lush that it creates lodging and high moisture under fallen plants, which promotes fungal diseases.

> "A number of fungicides are available for both early- and late-season control of foliar diseases.

Variety Selection

Selecting seed varieties each growing season may be one of the most important decisions farmers make in managing diseases. Resistant varieties provide the best protection from diseases, yet not all varieties are resistant to all diseases.

For this reason, experts recommend selecting two to three varieties with the highest level of resistance to diseases most commonly found on your farm and general area. If you haven't gathered historical disease data on your farm through scouting, consult your retailer, crop advisor, Extension officer or your neighbours.

Planting multiple varieties is one way to diminish risk. A disease could inflict catastrophic problems on all of your wheat acres if only one variety is planted. Planting multiple varieties with different maturities also helps protect against the risk of certain diseases such as Fusarium head blight, also known as head scab, which often attacks when flowering

Health Wheat Crop

Fusarium Head Blight

coincides with warm, humid weather. By planting varieties with different maturities, not all of the wheat fields will flower at the same time, reducing the chance that all of your wheat will get hammered by scab.

Seed Treatments

Fungicide seed treatments provide economical risk insurance and protection against many diseases. Controlling diseases results in enhanced seed vigour and uniform stand emergence and staging, all of which may result in increased yield potential. Fungicide seed treatments can provide a healthy start for seedlings, especially in cool and damp conditions.

In the market we have seed treatment fungicides that promote more root growth for faster crop establishment and control seed and soil borne diseases, such as Rhizoctonia. They feature a combination of fungicides incorporating a complementary mode of action that supports resistance management.

Crop Rotation

Crop rotation provides a means of reducing disease carryover into the growing season following wheat, barley and other crops. Rotating crops reduces risk from diseases such as head scab, tan spot, Stagnospora leaf blotch, Septoria leaf blotch and Pythium root rot. Remember that it's important to keep watch against disease infection regardless of crop rotation, because some inocula are picked up and dispersed by wind.

Weed Control

Control of weeds serves as another beneficial IPM practice. Use tillage and/or herbicides to control volunteer wheat and other weeds.

Good weed control is important because weeds can become hosts to disease and reduce yields by competing with the wheat crop for water, sunlight, soil and nutrients. Volunteer wheat, for example, is a weed pest that can interfere with wheat production by allowing disease and insect pests to survive the period between crops. Weeds also hamper harvest, lower grain quality and result in dockage at the elevator.

Scouting

For effective and economical disease control, a commitment to early and frequent field scouting makes a big difference in identifying diseases before they become severe and rob yields. Yearly scouting also helps build a disease database in your fields so you can proactively manage disease in future crops. Many disease symptoms appear similar, and correct disease diagnosis is critical to determine the best control options.

To page 6

Fusarium Head Blight

From page 5

For help with disease diagnosis, consult with your Extension officer or crop advisor. Referring to a crop identification guide is also helpful.

Foliar Fungicides

Many diseases such as rusts, powdery mildew, Septoria leaf blotch and tan spot can be controlled by timely applications of labelled fungicides. The decision to apply fungicides should be based on disease prevalence, severity and whether the cost investment outweighs the potential yield loss and profitability.

At the least, the upper two leaves of the wheat plant should be protected from foliar disease, as that is where the photosynthate for grain fill is primarily generated. Grain fill requires photosynthesis unhampered by defoliation and foliar lesions caused by disease. For best effectiveness, good leaf coverage is a must whenever fungicides are applied.

A number of fungicides are available for both early- and late-season control of foliar diseases. Chemistries from two of the most commonly used classes of fungicides, triazoles and strobilurins, provide good-to-excellent activity against wheat leaf diseases. When used in conjunction with best management practices, they can help manage disease resistance. Wheat growers should consider fungicides with systemic movement and curative properties for the broadest protection from cereal foliar diseases. Strobilurin-containing products should not be applied after the flag leaf emergence to fields that might be threatened by scab infections, as this may lead to higher levels of mycotoxins, which will negatively impact grain quality.

Always use full labelled rates of fungicides and read and follow label directions.

Plan to Manage Cereal Diseases

A well-thought-out disease-management program, including best management practices, proper seed protection and selection and fungicide applications, should be implemented to sustainably manage diseases.

Before selecting a seed treatment or applying any fungicide, please read the entire label for the best possible results and to confirm that the product is effective on the disease you need to control. Not every product is suitable for every situation, and correct application technique will ensure the best results.

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Leaf Rust

Wheat Rust Diseases

Leaf rust, also known as brown rust, is one of the three major types of rust infections in wheat.

Rust diseases represent the most economically significant fungal diseases in wheat and other cereal crops worldwide, and they are widely distributed across wheat growing regions. With the capacity to form new strains of fungus, rusts can attack even previously resistant varieties. Rust diseases possess the ability to spread and travel long distances by dispersal of windborne spores and can rapidly develop under optimal weather conditions.

The three rust diseases affecting wheat are leaf, stem and stripe rust. Leaf rust is the most common of the three diseases. In some states, leaf rust disease occurs every year. Stem rust is not typically as prevalent as other rusts because many varieties are now resistant to the disease. Stripe rust is becoming an increasingly important disease, with recent outbreaks in the Great Plains states.

Leaf Rust

Identification and lifecycle

Leaf rust, also known as brown rust, is caused by the fungus *Puccinia triticina*. This rust disease occurs wherever wheat, barley and other cereal crops are grown. Leaf rust attacks foliage only. Identifying symptoms are dusty, reddish-orange to reddish-brown fruiting bodies that appear on the leaf surface. These lesions produce numerous spores, which can cover nearly the entire upper leaf surface.

Leaf rust spores are spread by wind and splashing water. Optimal environmental conditions for development of infection are temperatures ranging from 59 to 68 degrees F and at least six hours of moisture on the leaf surface. With wet weather and ideal temperatures, lesions are formed within seven to 10 days of infection, and spore production repeats another disease cycle.

Crop Damage

Leaf rust causes the most damage when severe rusting covers the upper leaves before flowering. Early defoliation can occur, reducing time for grain fill and leading to the creation of smaller kernels. Grain shrivels, and any nutrients produced – primarily in the flag leaf – are used by the fungal infection instead of being transported to the grain. Early infection can result in weak plants and poor root and tiller development.

Significant yield losses can occur from leaf rust disease. According to research, severe epidemics have caused yield losses of up to 14 percent. In some areas they have even surpassed 50 percent, depending upon weather conditions, disease development early in the growing season and variety susceptibility.

Grain test weight and yield damage correlates to the level of disease infection and how early in the season wheat leaf rust disease attacks. Some areas report 30 to 40 percent yield losses when infection becomes severe prior to flowering, with flag leaf damage exceeding 60 percent and, in some cases, up to 100 percent.

Stem Rust

Identification and lifecycle

Stem rust, also known as black rust, is caused by the fungus *Puccinia graminis f. sp. tritici.* It infects wheat and other cereals. Stem rust occurs when raised spots (pustules) form on stems and leaf sheaths, although occasionally they may form on awns, glumes and seeds.

Stem rust spots appear elliptical and differ from leaf and stripe rust in that they are more elongated. The spots form on both lower and upper leaf surfaces and look orange to dark-red in color. The margins on stem rust spots are ragged. Young pustules release numerous spores. Later in the growing season, spores transform and become dark coloured, hence the common name of black rust.

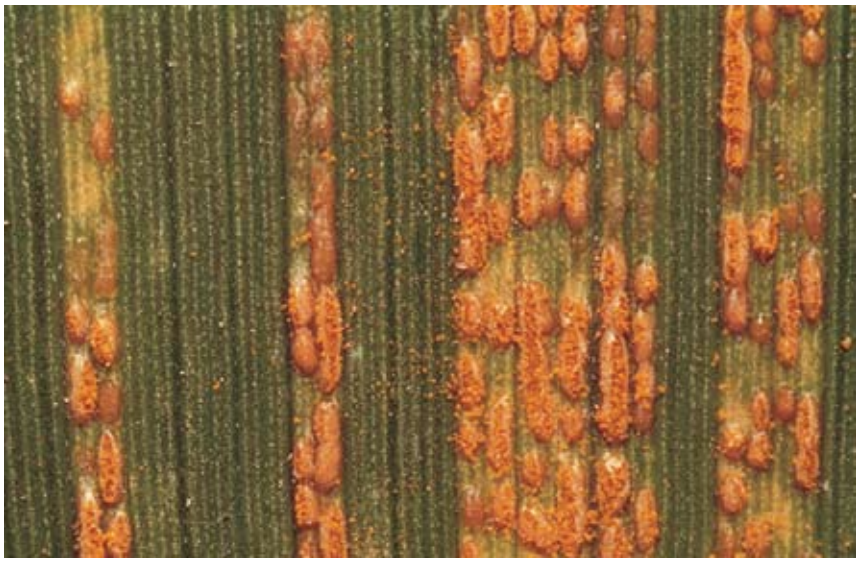
Stem rust development requires the warmest temperatures of the three wheat rusts –ideally 59 to 84 degrees F and six to eight hours of moisture on the leaf surface. With wet weather and optimal temperatures, new lesions are formed in seven to 10 days. Stem rust disease also spreads spores through wind dispersal and splashing water. Spores are produced in multiple cycles during the growing season.

Overwintering spores that develop in the previous year's wheat crop late in the season survive to produce additional spores, which spread via wind to infect wheat. Thus, another lifecycle is completed.

Crop Damage

The disease spreads rapidly and can travel long distances by wind or other means of transportation such as farm equipment or plant materials. With severe infections, the disease can turn a healthy crop into a tangle of black stems only weeks away from harvest, resulting in shriveled grain. According to the United Nations Food and Agriculture Organization (FAO), stem rust can result in 70 percent or more loss in wheat yield.
While stem rust has historically been the most damaging disease of wheat, it's not as prevalent today thanks to resistant varieties.

Stem Rust



Stripe Rust

Stripe Rust

Identification and lifecycle

Stripe rust, also known as yellow rust, is caused by the fungus *Puccinia striiformis f. sp. tritici*. The disease primarily occurs on leaves, although glumes and awns may also be affected. This part of the lifecycle leads to "hot spots" of infection seen in crops in later winter and early spring.

In lower humidity, stripe rust spores disperse more freely into the air and can travel for much greater distances. This may result in a uniform pattern of disease development beginning in mid-spring. In recent years, stripe rust has become more common globally. It reached high levels in early spring 2015 due an unusually wet spring across most of the region.

Stripe rust appears earlier in the season because development is enhanced by the cool, moist weather early in the growing season, versus leaf rust, which is more prevalent later in the spring when temperatures warm. Stripe rust develops under ideal temperatures of 45 to 54 degrees F with six to eight hours of leaf moisture.

Stripe rust typically produces yellow or orange blister-like pustules that are arranged in stripes. The lesions produce massive amounts of spores that are easily dislodged and dispersed by wind. The spores may leave orange dust on the clothing of individuals walking through heavily infected fields.

When stripe rust spores land on a living wheat leaf, germination and infection can result. Growing inside the leaf, stripe rust produces new lesions containing new spores. Under high-humidity conditions during winter, most spores survive in small clumps that are relatively heavy and fall quickly out of the air when dispersed.

To page 10

From page 9

As a result, spores spread mostly over short distances and may appear in uniform patterns of disease seen in mid-spring. Several cycles of spore production occur throughout the growing season.

Crop Damage

According to research, it's possible for stripe rust to cause 100 percent crop loss in susceptible varieties if the disease begins early in the season under wet, cool weather conditions.

Managing Wheat Rusts

Farmers have several options to manage wheat rusts, including seed treatments, variety selection, scouting, cultural practices and fungicide applications.

Seed treatments

Using the correct fungicide seed treatment and rate is one way to provide effective and economical disease control in wheat production. Seed treatments protect seed and young plants from disease and other threats to plant health and yield. Areas commonly infested with rust also will need a foliar fungicide treatment to provide protection beyond the seedling growth stage.

Variety selection

Where available, use rust-resistant varieties for best protection against leaf rusts. Every commercially available wheat variety has a unique disease package, and excellent disease resistance is not available to manage all disease threats in high-yielding varieties. It's best to select two or three high-yielding varieties that offer the best resistance to common diseases found on your individual farm.

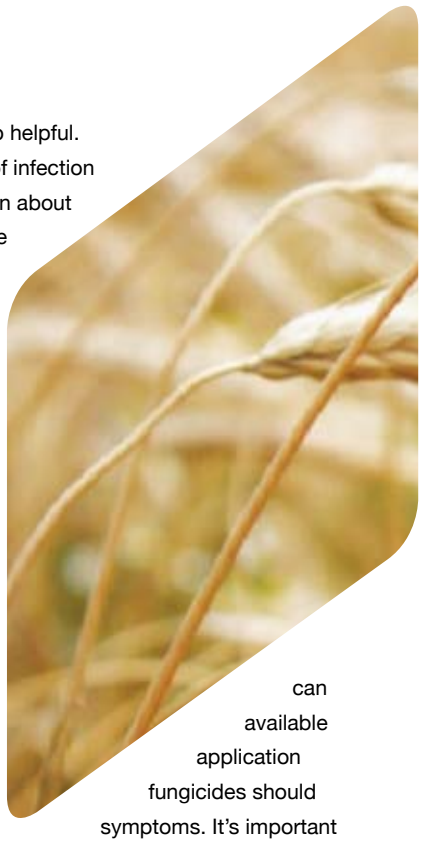
Scouting

When scouting for weeds and insects, check for the presence of wheat rusts and other diseases. Monitor reports of wheat rust development occurring in your area. This will allow you to track the progression of rust diseases migrating north from overwintering hosts and will also help you predict the timing and severity of infestations before they might affect your region. Keep a close eye on weather conditions because rust spores spread through wind currents to promote disease infection.

If you suspect leaf rust, stem rust or stripe rust infection, take samples and work with your agronomist to confirm a diagnosis. Crop identification guides are also helpful. Scouting helps determine levels of infection so you can make the best decision about the necessity and rate of fungicide applications.

Cultural practices

Disease-free seed gives seedlings a good start. Good weed control preplant, at planting and throughout the growing season also helps protect against disease and other pests.



Fungicides

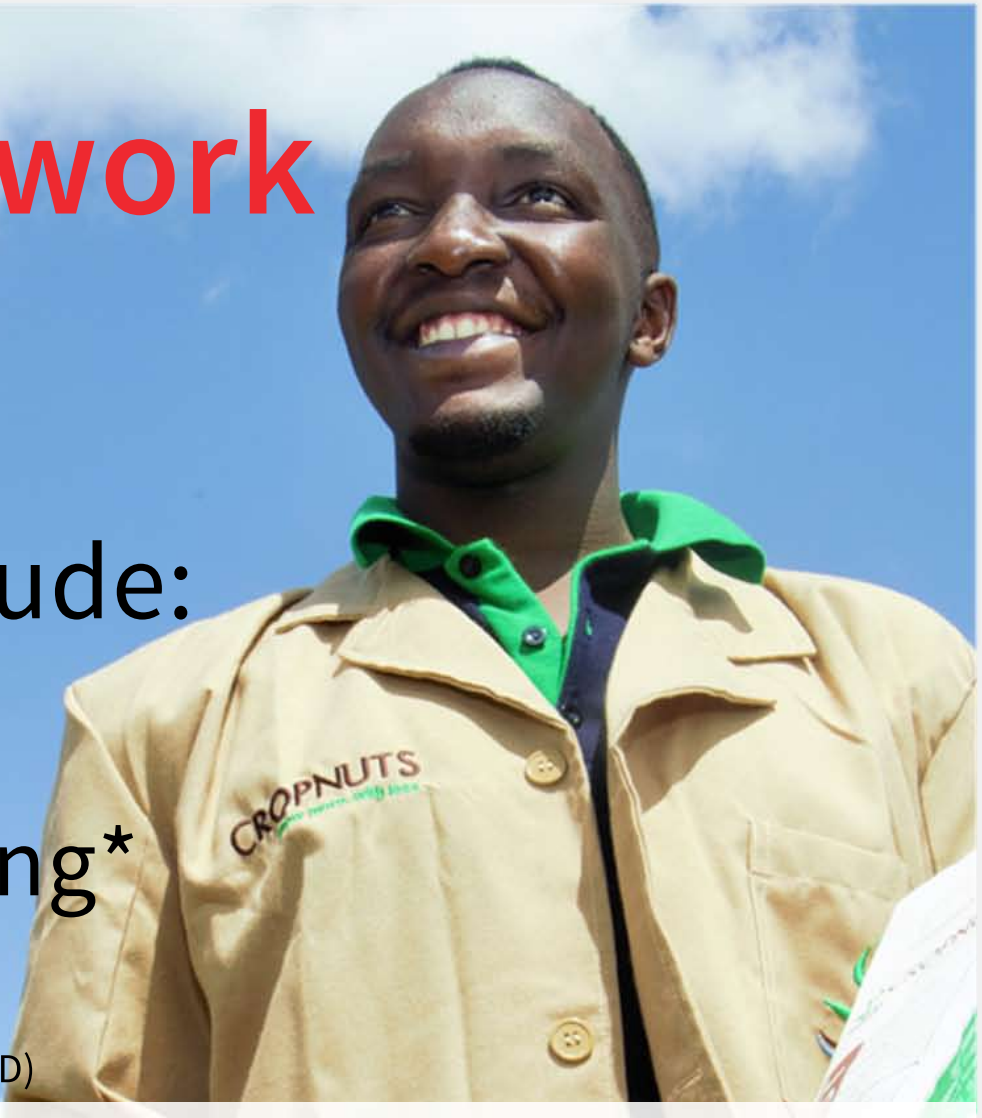
Good control of wheat rusts can be achieved with commercially available fungicides and proper application timing. The decision to use fungicides should be based on scouting for symptoms. It's important to assess disease severity from the onset of infection through the various growth stages. Application timing should take into consideration that diseases should be managed before infection reaches the upper leaves. Other factors affecting fungicide application are infection levels in the field, the susceptibility of the variety and the market price for wheat grain.

Conclusion

A well-thought-out disease-management program, including best management practices, proper seed protection and selection and fungicide applications using multiple modes of action, should be implemented to sustainably manage diseases.

Before selecting a seed treatment or applying any fungicide, please read the entire label for the best possible results and to confirm that the product is effective on the disease you need to control. Not every product is suitable for every situation, and correct application technique will ensure the best results.

Take the guesswork out of farming



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Choosing the Right Herbicides

What's one of the keys to effective weed control? Choosing the right herbicide, of course. And ideally, that means using the best product available for each of the weeds you plan to tackle in your fields. While it can be tempting to choose the cheaper option, such as a generic product, it might not be the best choice for maximizing efficacy to control weeds.

Choosing the right herbicides

Choosing the right herbicides is all about finding the product that is the best fit for your operation. To find the right products for your operation, first ask yourself the following three questions:

1. What are the weed species I am trying to control?

Identifying the problem weeds in your field is the first step to finding the right herbicide for your operation. Choose herbicides with active ingredients that are effective against these specific problem weeds.

2. What are the soil characteristics of the field?

When selecting an herbicide, soil type, pH and organic matter content are all important characteristics to minimize crop injury and carryover to subsequent crops.

3. What is my end goal?

Select an herbicide based on what you want to accomplish, whether it is prevention or elimination of weeds, or both.

Not all herbicides are created equal

Is there a big difference between active ingredients in original vs. a generic herbicide? Typically, no. However, how the products are manufactured is what really separates the two by affecting quality and performance.

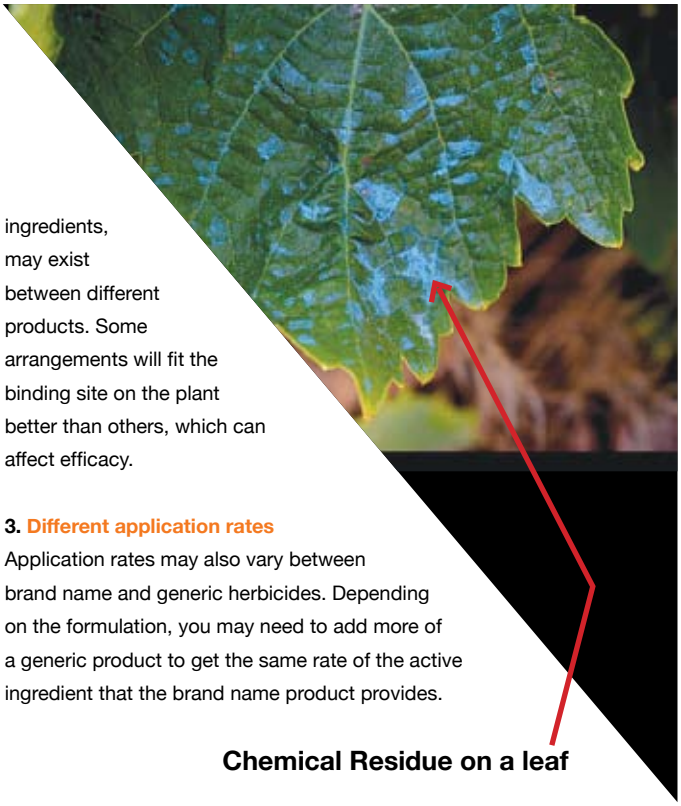
Overall, originals and generics differ in five key ways.

1. Different surfactant package

While generics and brand name products may contain the same active ingredients, they are not required to have the same surfactant package. Such differences can influence how well an herbicide sticks to the leaf surface and can make a difference in the performance of the herbicide.

2. Different molecular arrangements

The physical form of the active ingredient can also vary between generic and brand name products. Isomers, or different molecular structures of the ingredients, may exist between different products. Some arrangements will fit the binding site on the plant better than others, which can affect efficacy.



Chemical Residue on a leaf

3. Different application rates

Application rates may also vary between brand name and generic herbicides. Depending on the formulation, you may need to add more of a generic product to get the same rate of the active ingredient that the brand name product provides.

Herbicide Spraying

4. Different acid equivalencies

A generic product may also have lower acid equivalencies than a brand name product. Acid equivalency (A.E.) is a measure of herbicide efficacy. Products with lower A.E. require higher use rates to get the same amount of acid equivalent per acre.

Branded herbicides provide a trust and comfort level over generics.

Three Benefits of Selecting a Residual Herbicide to Control Weeds at Planting

After planting, there is one sight every grower dreads to see—weeds. It can be especially troubling when young weeds are visible before the crop even has emerged. These early season weeds pose one of the greatest threats to corn plants. If left unmanaged, they will compete with corn for sunlight, water and nutrients, often resulting in reduced yields and lower profits. However, as dreadful as weeds can be, there are strategies you can take to mitigate their effects. In fact, before you even see a weed, you can take steps to ensure that corn plants grow without unnecessary competition and yield losses.

One of the most promising ways to eliminate early season weed competition is by applying a pre-emergence herbicide with strong residual control.

Three benefits of selecting a pre-emergence herbicide with residual

Pre-emergence, residual herbicides take out weeds before the crop emerges from the ground. While important, this is only one part of the picture.

Of course, the initial control of emerged weeds is very important. But in order to keep those weeds at bay throughout the season, you really need an herbicide that not only controls weeds, but provides powerful residual too. This gives you a strong foundation for a solid integrated weed management program. The benefits of pre-emergence herbicide applications can be felt not only early in the season, but also later in the season and in future growing seasons as well.

Weeds

1. Minimizes weed-related yield losses

Early season weeds pose the greatest threat to yield. Managing weeds with a pre-emergence herbicide takes out tough weeds before they can compete with corn. Competition often results in improper development, with the corn plants growing taller rather that developing a solid root system that will allow for maximum grain fill. Availability of ample resources allows corn plants to develop fully and properly. Therefore, less competition from weeds minimizes the risk of reduced yields.

2. Builds a foundation for weed control later in the season

Applying a residual herbicide at time of planting can build the foundation for season-long weed control. Most residual herbicides remain active in the soil for a few weeks, so this extends the window for a postemergence application. When early season weeds are controlled by a pre-emergence herbicide with residual, there is less pressure on the postemergence herbicide application to take out all weeds that might have emerged since the beginning of the season.

3. Mitigates the development of herbicide resistance

As part of a two-pass system, a pre-emergence herbicide application can also mitigate the development of herbicide resistant weeds. It is recommended to incorporate multiple and different effective sites of action into the tankmix. With this approach, weeds are targeted in multiple ways for early season weed control. When weeds are successfully managed at time of planting, the risk of developing herbicide resistance is reduced considerably.

Powdery Mildew in Cereal Crops

Powdery mildew, caused by the fungus *Blumeria graminis*, is one of the most common and damaging foliar diseases in wheat. Powdery mildew exists almost everywhere wheat is grown. As an obligate parasite, the fungus grows only on living tissue.

Powdery mildew is particularly a problem in regions with high nitrogen fertilization and high stand densities. Cool, moist weather conditions with high relative humidity – 97 to 100 percent – enhance germination of the fungal infection. Optimum temperatures for development of powdery mildew are 59 to 70 degrees F, typically making it the first leaf disease of the season. When temperatures climb above 77 degrees F, powdery mildew begins to deteriorate.

Powdery mildew is characterized by white, cottony patches (colonies) of mycelium and conidia (asexual spores) on the surface of the plant. They can occur on all aerial parts of the plant, including stems and heads, but are most conspicuous on the upper surfaces of lower leaves. The white colonies later turn dull gray-brown.

Identification and Lifecycle

Symptoms of powdery mildew are white, cottony patches (colonies of mycelium) and asexual spores (conidia) on the surface of the wheat plant. Although the white patches can occur on all aerial parts of the plant, including stems and heads, they are most easily visible on the upper surfaces of lower leaves.

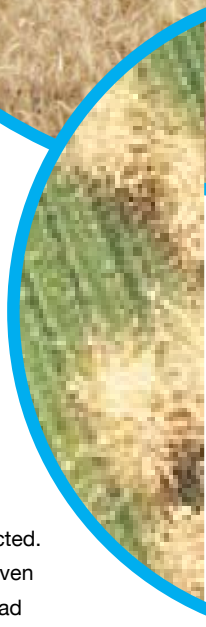
Later, the white colonies or patches turn dull gray to gray-brown in color. Severe infections can result in wheat plant stunting. Heads on the later tillers may show more heavy infection because they reside lower in the wheat canopy, where humidity remains high. The leaf tissue on the opposite side of the white mold growth turns yellow and then changes to tan or brown.

As plants mature, small, distinct black dots containing spores develop on plant leaves. In this phase of the disease, spores reside in older, gray-colored powdery mildew colonies that infect the wheat field.

Typically, the lifecycle of powdery mildew begins after wheat planting. The fungus overwinters on straw residue as white, cottony patches of asexual spores. Spring infections occur when spores are dispersed by wind and rain.

As the major cause of powdery mildew, these spores are produced in large numbers from initial infections.

Windborne spores land on plant surfaces and germinate, resulting in new infections on healthy plants or secondary infections on plants already infected. New spores can reproduce in seven to 10 days. The fungus can spread throughout the growing season, especially on susceptible varieties infected in early spring and when weather conditions are



> Excellent powdery mildew control can be achieved with commercially available fungicides.

Top Health Crop, Down Powdery Mildew

favourable.

Crop Damage

The greatest yield loss occurs when the flag leaf of a wheat plant becomes severely diseased by powdery mildew by the time of heading. Damage caused by the powdery mildew fungus increases the number of non-productive tillers, resulting in yield loss even at low levels of infection.

Disease infection robs yield by reducing kernel size, number of seeds per unit area and test weight. A rule of thumb is the earlier a spring mildew infection begins and the higher up the plant it spreads by flowering, the greater the resulting yield loss. According to research, wheat yield losses from powdery mildew may be as high as 45 percent.

Managing Powdery Mildew

Farmers have to consider several components of their management strategy for powdery mildew on wheat, including seed treatments, variety selection, scouting, cultural practices and fungicide applications.

Variety selection

Every commercially available wheat variety has a unique disease package, and excellent disease resistance is not available to manage all disease threats in high-yielding varieties. It's best to select two or three high-yielding varieties that offer the best resistance to common diseases found on your individual farm.

Scouting

When scouting for weeds and insects, check for the presence of powdery mildew and other leaf diseases. Scouting helps you make the best decision about whether or not a fungicide application is needed, and it also provides information to help you select appropriate disease management practices for future crops. If you suspect powdery mildew, take samples and work with your county Extension agent to confirm a diagnosis. Crop identification guides are also helpful.

Cultural practices

Crop rotation can help deter diseases. In areas where continuous wheat is grown, cultivation can break down crop residue that harbours certain diseases. Plant disease-free seed. Good weed control from preplant, at planting and throughout the growing season also helps protect against disease and other pests.

Fungicides

Excellent powdery mildew control can be achieved with commercially available fungicides. The decision to use fungicides should be based on scouting for symptoms. It's important to assess disease severity from the growth stages of tiller elongation through flowering. Experts recommend application timing to keep the upper leaves of the wheat plant disease-free, allowing full potential for grain fill. Other factors affecting fungicide application are infection levels in the field, the susceptibility of the variety and the market price for wheat grain.


Esmahane Eloufi, Chief Scientist, FAO

FAO's Chief Scientist Talks Tech, Innovation, and Food

Today, drones spray pesticides to prevent locust infestations, record aerial footage for crop assessment, and locate herds of cattle spread out over vast grazing lands. Alternative proteins, such as lab-grown meat, can help reduce agricultural greenhouse gas emissions and resource use. Gene editing for seed improvements can produce more crops and improve nutrition outcomes. Blockchain can ensure fair wages for farmers and encourage more transparency in food systems.

There are as many negative impacts of these technologies as there are positive ones, however. So are technology and science really silver bullets?

Today we discuss the future of innovation and the challenges in implementing new technology on the ground to make food production and consumption more effective, equitable, and environmentally sustainable. *This conversation has been edited for length and clarity.*

How can technology and innovation tackle rising food insecurity?

Agriculture is not a stand-alone sector. Everything is interconnected. Biodiversity loss feeds into climate change, which feeds into problems of production. We have to recognize that complexity to be able to design a food system that works better for people and prosperity.

Nature is complex, but it's perfect. We need to understand the pathways in nature which are interconnected. If we understand them, we should be able to produce food by mimicking nature.

Thirty years ago, we had no clue what was happening at the genetic level. Many new technologies happened right after we discovered how to read DNA — how to understand the composition of genes, how they are expressed, and how they are transcribed. Now with the new technology on gene editing, this will allow us to go into the gene and change sequences to trigger certain proteins or certain enzymes or certain metabolites. This is a technology that can be a breaking point in history.

Also, when you think about biodiversity, we're talking trillions of cells. Or when you look at the soil, you've got trillions of microorganisms. We finally have big data, which gives us the ability to connect the genomic data with the weather data, with the productivity data, with the nutrition data. We also have the ability to understand it, analyze it, and use artificial intelligence to manage it and make it perform better in terms of analysis and intervention. The possibilities are endless.

What challenges do low- and middle-income countries face with the implementation of technology and innovation?

For every problem, I see a solution in science, innovation, and technology. But


Maize Crop


Sorghum

having the solution does not always allow you to deploy it. You need a conducive environment that allows you to really scale out and scale up.

Some technologies have existed for some time, but they've never made it to the ground. The challenge is really the understanding of certain communities or countries about the technologies and the risk around them.

In science, you need the proper design, [and] you need to have enough repetition [and] enough data to analyze it and make sure that it is good. The rigor behind science should be applied when we talk about new technologies. After that, it has to go through policy and regulation [processes], and that's where science, policy, and society interface. We need better mechanisms to really bridge between these three groups, because right now that relationship is a little bit linear rather than [going] two ways.

Unfortunately, most of the innovations that made a difference in the developed world did not make any difference at all in the least-income countries, and it's because it never reached them.

In Africa, you look at the whole continent, and only about 7% of agricultural land is irrigated. The reason behind it is infrastructure and affordability. Most of those technologies are way too expensive. That's really where our focus should be.

How do we make these technologies affordable and accessible?

The only way to make it affordable, in my mind, is really to make a manufacturing blockchain. You need to develop the SMEs [small and medium-sized enterprises] so that seeds, fertilizers, and irrigation materials are produced locally or at least regionally. The fact that they import so many of those inputs from the outside makes it very expensive. We need to look at how we could develop an ecosystem, where the different pieces are interconnected, are affordable, and are close to the farmer.

Also, once you develop something, the know-how and the technology has to be transferred to the farmers. So there is a need to look at how we could make sure the knowledge goes to the farmer and how we could help some of the countries to really rebuild or re-imagine their extension services [for transferring this knowledge to the farmer], either through public services or a combination with the private sector.

"The pandemic really pushed us in the corner and gave us a chance to fundamentally rethink the way we produce, process, and consume food."

There have been proposals for a new international platform for food systems science. Is another research body necessary?

There are always ways to improve things. It took us forever to really recognize that nutrition and agriculture are interconnected. For me, the Committee on World Food Security is a very strong mechanism that exists, but the CFS is heavy, like all very old organizations or committees. But still, it has all the parties in it: civil society, government, private sector.

What we need to do is strive to make an easier way to come to an agreement on how technologies could be deployed or, for example, how could we eradicate malnutrition by this number in this region.

So that's where, during the [United Nations' planned] Food Systems Summit, we have to find solutions. And those solutions have to be deployed the right way. [We need to] focus on the efficiency, the inclusiveness, the resilience, and sustainability of the food system and make sure that, by the end, we are providing a healthy diet for all. So for me, it doesn't matter what the tool is. We have to agree on the target.

The 2nd National Agriculture Summit 2022

By Mary Mwende Mbithi

Daniel Webster, a lawyer and statesman from the United States of America, once said, “Let us not forget that the cultivation of the earth is the most important labour of man. When tillage begins, other arts will follow. The farmers, therefore, are the founders of civilization.” True to that, agriculture has or rather was man’s early way of life. Agriculture has sustained the globe over the years, providing food as well as employment. It is indeed the cornerstone of all industries.

Recently, the 2nd National Agriculture Summit took place at the Kenya Agricultural Livestock and Research Organisation (KALRO) in Loresho, Nairobi. Agriculture Sector Network (ASNET), together with the ministry of Agriculture, Kenya Private Sector Alliance (KEPSA) and all Agriculture stakeholders held discussions on what should be done for agriculture to become more profitable.

Under the theme, ’Accelerating Private Sector investment in agriculture for growth and transformation, the two-day summit aimed at identifying opportunities to boost productivity and sustainability across all agricultural value chains.

The summit brought together different stakeholders and experts drawn across the divide. Among them was CAS Agriculture Lawrence Omuhaka who was sitting in for CS for agriculture, Livestock and Fisheries Peter Munya. He gave an assurance of government’s support in order to attain food security in the country. He noted that one of the hurdles faced by Kenya currently is the high cost of production. He therefore assured of measures being to lower the cost of feeds.

Reading CS Munya’s message, he said, “Transforming the agriculture sector will provide the tools to combat price and volatility, improving the environment for private investment, and developing more strategic approaches to bring down the country’s dependence on food imports.”

Dr. Bimal Kantaria, Chairman ASNET

According to Jane Ngige, Vice Chair ASNET, While enumerating the achievements made by ASNET since its inception, she said, agriculture is not only the backbone of Kenya but also the largest source of Kenya’s Gross Domestic Product (33%), employing more than 40% of the total population with 80% as rural population and accounts for over 65% of all export earnings. It provides livelihoods to more than 80% of the population in Kenya.

“We need to re-define the role of the small-scale farmer and the SME agro processor in their contribution to the economy. We are pushing for the allocation of at least 10% of the national budget to Agriculture since the sector contributes about 33% of the country’s GDP and accounts for 80% of national employment, mainly in the rural areas,” She noted.

During the summit, PS state Department of livestock, PS Harry Kimtai also affirmed of government’s partnership with ASNET to streamline agribusiness policies in the country.

This comes at a time when the Agriculture sector is reeling with reduced growth and already facing the adverse effects of the global food crisis especially the surging costs of

living which in turn are aggravating the cost doing business by SMEs. Ms. Agatha Thuo, ASNET's General Manager, reiterated on the need for the government to provide an enabling environment and focus on the role of SME's.

With all these bottlenecks, still the agriculture sector's overall market value of agricultural production went up by 4.3% from Ksh 505.3 billion to Ksh 527.0 billion in 2021 according to a 2022 economic survey. Dr. Bimal Kataria, the chair of ASNET and Director of Elgon Kenya, in his own words emphasized on the need for a united, innovative and proactive approach that cuts across the value chain.

He went on to say that, a firm industry cannot manage on its own without a sane policy framework and timely government interventions in key areas that support private sector to deliver. Highlighting the challenges faced by the agriculture sector Dr. Bimal spoke of the setbacks that were brought about by Covid-19 pandemic after most countries imposed curfews and lockdowns in a bid to curb the spread of the virus.

Again the escalation of the war in Ukraine has caused inconveniences to the farmers with the costs of farm input like fertilizer soaring. This clearly translates to farmers risking and planting without fertilizers due to unaffordability.

He therefore urged the government to subsidize the fertilizer in a bid to make it easier for the private sector to supply the sector. "We've worked hard with the government to bring down some of the taxes that have been imposed on agricultural inputs. The government has been responsive on the matter and we hope to see changes soon."

There is a shortage of Maize and Wheat due to the war in Ukraine. Thirty percent of Kenya's wheat comes from Ukraine. "We are taking mitigating factors asking the government to give us a waiver of duty on maize and wheat. There's a slight amendment that we are waiting for, that's the treasury to make it 99.1% non-GMO maize and wheat which will allow us to import from places like Latin America."

Others in attendance included, Ms. Flora Mutahi – Chair, KEPSA, , Mr. Victor Ogalo – Deputy CEO – Business, KEPSA; Dr. Wilson Songa – Director, ASNET; Mr. Tito Arunga – Head of Agribusiness, Food & Agriculture Organization (FAO); Mr. Mucai Kunyiha – Chair, KAM & KEPSA Director; Arch. Lee Karuri – KEPSA Trustee; Ms. Waithera Gaitho – Vice-Chair, KEPSA ICT & Youth Sector Board among others who joined both physically and virtually.

Group Photo

Can Irrigation be an Answer to Kenyas Food Security Problem?

By Dennis C Otieno, Lilian Kirimi, Nicholas Odhiambo

Irrigation development is one strategy the government can use to improve food security in Kenya. Lessons from irrigated maize production studies show that it is profitable and that Galana Kulalu food security project has the potential to produce about half of the country's food requirement contributing significantly to food security and the GDP through the incomes earned. However, high costs due to inefficient use of fertilizer, water and land are the major cost factors that have caused doubts and low level engagement in irrigated maize production.

It is thus recommended that efficient use of land, fertilizer and water under both intensive and extensive maize production under irrigation, would contribute to lowering the unit cost of production and lead to increased food production.

Major cost elements

The overall cost of production for irrigated maize was KES 15,705 per 90kg bag for the 2014/15 crop season. This is about 20% higher than that for non-irrigated maize which is KES 13,100 per 90kg bag. Evidence shows that the major factors contributing to this high costs are fertilizer, water and land preparation contributing 28.1%, 19.6% and 15.9% respectively

The intermediate factors (pesticides, herbicides, transport, gunny bags, storage chemicals and their handling charges) and seeds have a relatively lower cost of 10.7% and 8.6% respectively. These two factors were sourced through farmer groups which lowered their procurement costs considering that these are marginal areas.

Poor road network and insecurity have made transport to be the most expensive factor in this category. Although the demand for labour was high, irrigated maize production experienced limited labour supply which contributed only 13.1% to the total cost. ASAL areas experience labour shortage due to the low population in these marginal areas.

Labour scarcity raises the wage rates for labour in irrigated farms making them much higher than non-irrigated farms. This has resulted in most farmers using family labour in field activities resulting in the apparent low cost of labour.

Revenues

The profit margins per acre and per bag under irrigated maize of KES 8495 and KES 772 respectively, were higher than KES 5003 and KES 658 for non-irrigated maize. The breakeven point was however inversely

related to price and directly related to the cost of production.

Irrigated maize had a breakeven point of about 7 while non-irrigated maize had 5. Increasing maize price is associated with increased margin per bag. Irrigated maize also has an additional advantage in that output and profits can be increased by increasing the number of seasons.

Efficiency tests

The results were used to estimate the statistics for efficiency test. The results show that fertilizer, water and land were inefficiently used while there was near optimal use of seeds and labour.

Optimal rates of application for fertilizer and water needs to be developed for different methods of water application. Water and land are significantly underutilized and this led to low output. The available option for increased production is to intensify the use of these factors on a small scale. The use of water saving technology and intensive land use would prevent excessive land and water wastage. Labour and seeds were well utilized.

Conclusions and Policy Implications.

In conclusion, this study establishes that: Irrigated maize is profitable and the most important factors of production are fertilizer, water (amounts and method of application), labour and preparation practices. Irrigated maize is beneficial since it returns a high margin of 29% more per bag than non-irrigated maize, has higher output levels and its profit margins are higher. It is important to note that a 1% price increase increases profit margins by 0.615 % and cost margin by 29%.

The production of irrigated maize is flexible and one can have more than one crop in a year. This implies that high returns can be achieved if production is targeted at seasons when there is low supply of maize in the market.

The major cost limitations are the high cost of production due to high factor costs, small farm sizes, price fluctuations and limited labour. In terms of production, fertilizer, land and water have a significant effect on maize production though they are inefficiently used. Fertilizer is excessively used while land and water are underutilized.

Policy insights

The high profits, income and low cost per bag for irrigated maize is a sign of a viable venture though it has challenges for Galana-Kulalu food security project.

The project has the potential to increase the country's maize output by about 5.5 million bags considering one seasons output and about half of the national food requirement i.e 16.5 million bags if they are to produce for three seasons. This is quite a substantial amount and can improve the food security situation and the GDP of the country.

However, there are challenges which needs to be addressed among them competing political interests in water use, human wildlife conflicts, insufficient water, high cost of irrigation investment, land use rights and the value chains for effect of large output levels on consumer and producer price levels have to be addressed so as to maintain all stakeholders gainfully employed in maize business.

What can be done to increase food production?

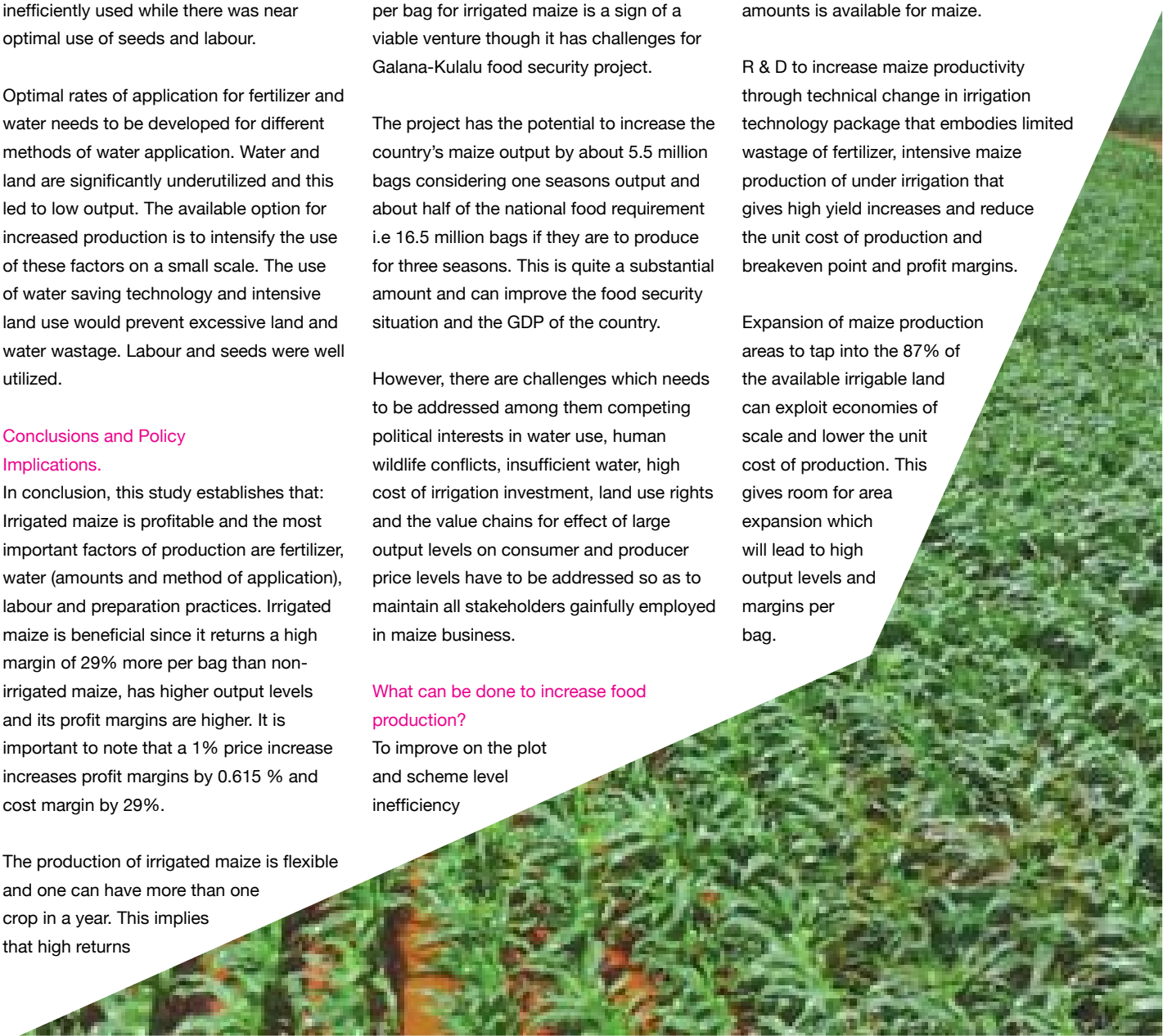
To improve on the plot and scheme level inefficiency associated with irrigated maize production and hence food production, the following actions are recommended.

Efficient use of water and water application methods since the factor is scarce. River Galana inadequate water means that centre pivot a more efficient water application method.

With the cost for water being paid for as a lump sum, cost reduction can be achieved through efficient use of water and water application methods. This would lower the water wastage and ensure sufficient amounts is available for maize.

R & D to increase maize productivity through technical change in irrigation technology package that embodies limited wastage of fertilizer, intensive maize production of under irrigation that gives high yield increases and reduce the unit cost of production and breakeven point and profit margins.

Expansion of maize production areas to tap into the 87% of the available irrigable land can exploit economies of scale and lower the unit cost of production. This gives room for area expansion which will lead to high output levels and margins per bag.



Amiran

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Common Cer

Stem rust

Cereal farmers continue to face challenges with controlling different forms of rust and Fusarium head blight. The most notorious form of rust is stem rust (Black rust). Stem rust reduces yields and quality of grains and may cause up to 100% yield loses. Over time the greatest challenge facing wheat production in Kenya and globally has been getting varieties that are resistant to the deadly Ug99 strain of stem rust.

Stem rust urediniospores are well-suited for wind dispersal. They are dark-coloured and can tolerate exposure to ultraviolet light, are adapted to a wide humidity and temperature range and are carried in wind currents at altitudes up to 4.5 km.

Another form of rust is yellow rust. Cold, damp weather in the spring, with overnight dew or rain, provides the best conditions for the disease to spread, with characteristic symptoms being parallel rows of yellowish orange coloured pustules on adult plant leaves.

Yellow Rust in wheat

AMIRAN WHEAT AND BARLEY PROGRAM

STAGE	LAND PREPARATION	PLANTING AND GERMINATION	TILLERING
HERBICIDE			Kiboko Super + Ariane
SEED TREATMENT		Seed Power Broadhectare	
SOIL pH ADJUSTMENTS		Amiran Calcipower	
BASAL FERTILISER		Agromaster 20:30:2	
MICRO NUTRIENTS		Tiger Trace	
INSECTICIDE		Buffalo/Triger	Aster Extrim/Triger
FUNGICIDE			Orius/Atlas
FOLIAR FEED			Polyfeed
ADJUVANTS		Amisil Superlink	Amisil Superlink

real Diseases

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Yield losses of 40–50% often occur in untreated susceptible wheat varieties. However, varietal resistance and well-timed fungicide sprays are usually very effective, so annual losses are often small. In addition, yellow rust affect grain quality.

Amiran Kenya has introduced duo triazole product as a tool to address serious diseases affecting cereal growers. According to Timothy Munywoki, Chief Agronomist at Amiran Kenya Ltd, Atlas 300 SC (Propiconazole 150 g/L + Difenoconazole 150 g/L) will cure diseases such as Fusarium Head Blight especially in Mau Narok and Timau where the disease is rampant. Atlas will address other diseases such as Stem Rust, leaf rust,Yellow rust, Netblotch,Scald, Septoria among other leaf diseases.

Fusarium Head Blight

Propiconazole and Difenoconazole is classified by FRAC as a demethylation inhibitor (G1)Inhibits the formation of critical fungal cell membrane ergosterols, primarily by blocking the action of 14-□-sterol demethylase, the only cytochrome common to fungi.

Atlas has the following advantages to the grower

- Powerful performance against Fusarium Head blight.
- Proven deoxynivalenol (DON) reduction in harvested grain.
- Preventive and curative action against a wide range of leaf diseases.
- Increased grain quality and higher yields.
- Strong performance on wide range of diseases.

	STEM ELONGATION	BOOTING	EAR EMERGENCE	FLOWERING AND MILK DEVELOPMENT	DOUGH DEVELOPMENT & RIPENING
	Buffalo/Triger	Rapid/Triger	Aster/Triger		
		Othello Top		Orius/Atlas	
	Super Nitro	Polyfeed	Multi-K	Multi-K	
	Amisil Superlink	Amisil Superlink	Amisil Superlink		

Challenges for Kenya in big pus

By Timothy Njagi and Priscilla Wainaina

Five years ago, the Kenyan government announced its "big four" development strategy to be implemented over the next five years. Food security was one of the key strategies. The others are affordable housing, manufacturing and universal health care.

In the realm of food security, the reduction of post-harvest losses has been identified as a way to boost production. This is in addition to expanding the area used by commercial agriculture for staple crops, expanding irrigated agriculture and increasing the use of yield enhancing inputs.

Kenya estimates that 20% of cereals are lost even before reaching the market. That's a high figure, particularly since it doesn't include food waste. Food waste refers to good quality food that is fit for human consumption but that does not get consumed because it's discarded, either before or after it spoils.

Food loss refers to quantity and quality, in which the economic value of produce is degraded. Such food may even become unsuitable for human consumption.

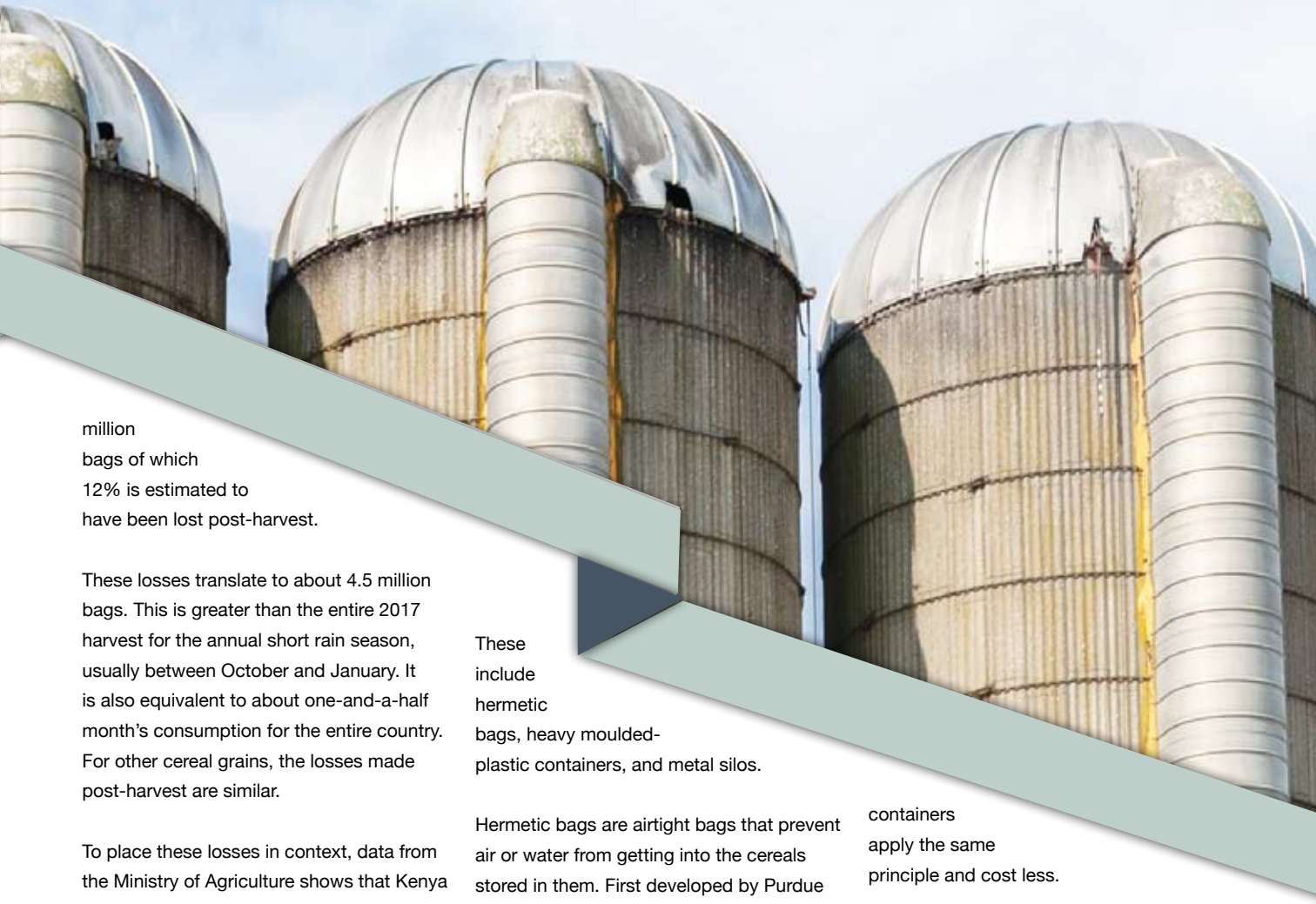
In Sub-Saharan Africa as much as 50% of fruits and vegetables, 40% of roots and tubers and 20% of cereals, legumes and pulses are lost before they even hit the market. In recent years problems with food safety have also contributed to post-harvest losses.

Poor food handling, including poor storage and sanitation, may also result in food losses. Food safety standards and practices have been put in place in Kenya but not all are feasible for adoption by small farmers and traders. More must be done to help people who fall into these groups if the country is serious about tackling food loss.

Kenya food losses

As the president was announcing this, food situation assessment was carried out. It showed maize losses could be quite substantial. The country produced 37

sh to reduce post-harvest losses



million
bags of which
12% is estimated to
have been lost post-harvest.

These losses translate to about 4.5 million bags. This is greater than the entire 2017 harvest for the annual short rain season, usually between October and January. It is also equivalent to about one-and-a-half month's consumption for the entire country. For other cereal grains, the losses made post-harvest are similar.

To place these losses in context, data from the Ministry of Agriculture shows that Kenya imported 8 million bags of maize between May and December 2017. The total cost of importation and rebate to millers was USD$67 million.

Different geographies

Many of the interventions in post-harvest storage and management in Kenya have focused on on-farm storage. A number of technologies that improve grain storage at the household are available to producers.

These
include
hermetic
bags, heavy moulded-
plastic containers, and metal silos.

Hermetic bags are airtight bags that prevent air or water from getting into the cereals stored in them. First developed by Purdue University, they preserve the contents while restricting the existence of cereal pests by depleting oxygen supply levels and producing carbon dioxide. These bags are considered practical and cost effective at approximately USD$2-3 in Kenya.

A metal silo is a cylindrical structure, constructed from a galvanised iron sheet and hermetically sealed, killing any insect pests that may be present. Plastic

containers
apply the same
principle and cost less.

These technologies are aimed at increasing the length of storage. They also protect grain from rodents, grain borers, weevils, moths and other pests and minimise the use of pesticides.

But their adoption remains low for several reasons: constraints in accessing income and credit access, physical access,

To Page 26

From Page 25

education and knowledge barriers.

Several other approaches should be considered to effectively address post-harvest losses. These include both on-farm and off-farm storage and handling. For instance, farmers were able to increase their yields by up to 30% by mechanising the harvesting process in Kenya's main rice producing area of Mwea. This reduced the losses that occurred from manual harvesting and

Hermatic Storage

low-cost technologies through the private sector. These investments led to the development of PIC bags and metal silos.

Further work is still going on to develop post harvest storages such as cocoons and improved traditional granaries at lower costs so that farmers can afford them. But more must be done so farmers know about such technologies and adopt them.

packing of grain for storage.

However, two key hurdles will have to be overcome to effectively address the challenges. First, the methodologies to measure losses for different crops, across different geographies and value chains have to be improved. Second, investment in collecting reliable data on how much is lost for different commodities is required.

Betting on private sector

The Kenyan government is betting on the private sector to reduce post-harvest losses. This alone will not be effective since the private sector may not be able to adequately fill the knowledge gap when it comes to understanding the use and importance of these technologies among farmers. In addition, farmers with scarce resources may be excluded from using the technologies developed and distributed through the private sector.

Several big funders, such as the Bill and Melinda Gates Foundation and Rockefeller, have already invested heavily in developing

The government should also invest in generating data to inform private sector investments. Private sector investors require data on gaps, such as areas with the highest losses, causes of these losses, farm and farmer characteristics to develop appropriate solutions. Generating this data may be out of reach for private sector investors. Additionally, private companies are unlikely to share such information with competitors if they made the investment.

The partnership with the private sector is a great step in reducing post-harvest losses. Additionally, helping farmers overcome barriers to post-harvest management will be a big boost in reduction of these losses and improve food availability. However, these interventions should begin before rather than after the harvest.

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Leasing Vs. Buying Agricultural Machinery

Producers are considering other options for obtaining machinery services due to increasing equipment costs, obsolescence of owned equipment, and limited sources of outside debt capital.

When operating an agriculture business, every decision you make is important, and everything you decide to spend money on matters. It is, therefore, essential to think about what you need to purchase outright so as to ensure your company can thrive, while also being aware of what you can lease to keep operations ticking over.

Machinery and equipment expense typically represents a major cost in agricultural production. Purchasing equipment with the use of personal or business equity and loans from financial institutions or equipment manufacturers has been the typical method of obtaining machinery services for most farm operations.

Producers are considering other options for obtaining machinery services due to increasing equipment costs, obsolescence of owned equipment, and limited sources of outside debt capital. These options include leasing equipment, renting equipment, and obtaining machinery services from custom operators (i.e., custom hire).

Buying Equipment.

Purchasing is the traditional method of obtaining machinery or equipment. The farm manager buys a machine using equity or a loan from a dealer or financial institution. Ownership of the machine is transferred to the farm manager, who is responsible for making loan, insurance, tax, and non-warranty repair payments.

The owner also provides the labour or hires it and pays for all variable or operating costs such as fuel, lubricants, and routine maintenance. With a purchase, the machinery is set up on a tax depreciation schedule and the owner takes depreciation deductions.

If the machine is financed with a loan, the interest component of a payment is also tax deductible. If this expensing option has not been used by other capital purchases, it can be deducted in the first year of ownership. Variable costs such as labour, fuel, and repairs as well as insurance payments are also tax deductible expenses.

Advantages characteristic of buying farm equipment include:

- Owned equipment may be easily replaced or sold at the owner's discretion; replacing leased equipment may be more difficult.
- Owned equipment has asset value and may be used as collateral against other loans.
- Purchases do not require security deposits, although down payments to secure financing may be higher.
- Purchased equipment has no use limitations. Some leases specify the number of hours a machine may be used before a penalty is imposed.
- Increased asset value on the balance sheet.

Leasing Equipment.

A lease is normally a long-term contract for the use of equipment. These contracts typically last for several years. In the case of a lease, the machinery dealer or leasing company essentially provides financing for machinery services to the person leasing the machine, but retains ownership of the

Farm Machinery

machine.

The farm manager leasing the equipment typically is responsible for insurance payments, and repairs not covered by warranty as if the equipment had been purchased. The responsibilities for operating costs, including maintenance, fall on the farm manager just as they would if the machine had been purchased. The manager provides the labour for operating the machinery.

The main differences are that the financing is done with specified lease payments instead of a loan and the title to the equipment remains with the equipment dealer or leasing company. At the end of the lease, the equipment is owned by the equipment dealer and not the farm manager, however, terms often exist that allow the farmer to purchase the equipment at a market value at the end of the lease if they desire to do so. Leases generally cannot be cancelled by the lessee without penalty.

A lease or rental agreement may require a refundable or non-refundable deposit and will likely call for payments at the beginning of the lease or rental period. In a true lease agreement, the entire lease payment is deductible. A lease deposit also is deductible for producers paying taxes on a cash basis, but the deduction must be amortized (spread over) the life of the lease.

However, if the deposit is refundable, the deposit deduction will be subject to recapture on receipt of the refund. Operating costs are also tax deductible. Depreciation and interest deductions are not used.

Advantages characteristic of leasing farm equipment include:

- Lower up-front, down payment costs compared to purchasing
- Payments often are less than traditional loan payments would be
- Less liability on the balance sheet
- Equipment available for short-time needs

To Page 30

From Page 29

- Access to and use of latest technology
- Lease payments are considered production expenses for tax purposes

So, with that in mind, what are the key things you need to be aware of when choosing between buying and leasing your agricultural machinery? What are the benefits, what are the potential cons, and how can you ensure that you make the right choices to bring about business growth? Let's look at leasing vs. buying agricultural machinery.

1. Are you happy to cover all maintenance expenses if you buy outright?

A great example to consider here is a bulldozer. You will, undoubtedly, need a bulldozer to carry out some of your business' day-to-day functions, but given that brand new bulldozers are expensive, it may be a better option to lease than buy. This will allow you to update your bulldozer as and when necessary, upgrading to a new one without having to worry about selling your old one beforehand.

Another perk is that most hire contracts will come with some maintenance provision, so you won't have to worry about the expenses associated with upkeep and repairs. The same can't be said for any bulldozers you buy outright, although buying machinery does offer some benefits, including writing off parts of the machinery on your taxes and gaining equity.

2. Are you in a position to make monthly payments?

If your business' income fluctuates, and you cannot accurately predict how much profit you are going to make from one month to the next, then maybe committing to paying off an item via a lease is not something you should contemplate. You should also consider the length of the agreement as it allows you to spread the cost over a period of time which suits your business needs – and whether this is something you can afford.

3. What is your credit situation?

It could be that, if you have a poor credit rating either personally or as a business, your purchasing options will be limited. This will also likely impact how you are able to get hold of funds, how much you might have to pay back if you are given a loan, and how your credit score looks in the long-term.

4. Leasing vs. buying a tractor

It can be difficult weighing up the options when it comes to either leasing or purchasing a vehicle outright. The key is, really, how you want to manage your business cash flow. If you want to buy a tractor outright, this would require a large upfront investment, but could mean you save money in the long run. However, leasing gives you a more flexible finance solution to securing the equipment you need without affecting your cash flow, allowing you to manage other business expenses such as employee wages, business rates, utility bills etc. Again, as we have already stated, be very aware of your finances before you make a decision because the last thing you need is to purchase a tractor and then find out that you can't actually afford it.

The farm manager leasing the equipment typically is responsible for insurance payments, and repairs not covered by warranty as if the equipment had been purchased. The responsibilities for operating costs, including maintenance, fall on the farm manager just as they would if the machine had been purchased. The manager provides the labour for operating the machinery.

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Post-Harvest Losses: A Key Contributor to Food Insecurity in Kenya

By Kevin Onyango and Lilian Kirimi

• The national maize post-harvest losses are estimated to be between 12 and 20 percent of the total national production. At a 5-year national average production of 40 million 90-kg bags, the loss is between 4.8 and 8 million bags annually.

• The estimated national monthly consumption of maize is 3.39 million bags. Kenya, therefore, loses an equivalent of over 1 month of consumption or an equivalent of a whole short rains harvest, estimated at an average of 5 million bags.

• Strategies to reduce the losses such as promotion and investment in better post-harvest produce handling and management practices as well as appropriate and efficient on-farm and off-farm storage technologies are urgently required.

In the face of serious food shortages been experienced, Kenya's food security continues to be a major concern to policy makers and the entire citizenry. Key questions on how Kenya can transition permanently to a food self-sufficient state continue to be asked by all stakeholders.

Ironically, over 50 years after independence and with a number of legislations, policies and strategies, Kenya is still a food deficit country. However it is encouraging to note that in the recent past, the government has prioritised food security; currently food security is among the top four priorities to be addressed over the coming years.

Maize remains the main staple crop for the country with a 5 year average production of 40 million bags against an estimated demand of 45–50 million bags annually. Maize consumption (food use only) is estimated at 3.39 million bags per month or 40.7 million bags per year. This means that if all the maize produced went to food use, the country would still need to import around 1 million bags to meet the maize demand for food. This is further complicated given the need for maize for other uses including industrial manufacturing, seed and animal feed, which account for 2, 1 and 2 percent respectively.

Post-harvest losses are estimated at 12 – 20 percent of the total national production. The losses mainly include spillages during handling, transportation, processing and marketing; rotting and aflatoxin contamination due to improper handling and inadequate/inappropriate storage technologies; losses to pests such as

birds, insects and rodents; and, mechanical damages during farm level elementary processing and off-farm value addition. Together, these account for a loss of between 4.8 and 8 million bags annually. This loss would be enough to cover 1.4 months of consumption demand for the country.

Climate variability and change has also emerged strongly as a contributor to post-harvest losses. The changing climatic patterns have altered the maize harvesting period conditions in most parts of Kenya's grain basket with harvesting coinciding with rains or humid conditions in October-November-December. These conditions not only hinder proper grain drying but also provide conducive conditions for grain pests and disease build-up. Farmers without proper storage facilities (majority of smallholders) suffer huge losses as their produce is either rained on, lost to rot or severely infested by pests and diseases. This is part of the reason why farmers sell their produce immediately after harvest when prices are rock bottom.

Post-harvest losses are a major contributor to food inadequacy and must, therefore, be effectively addressed as a strategy to achieve the much desired state of food security. Use of several

strategies and technologies along the value chain can be regarded as low-hanging fruits towards efforts to improve maize supply in the country.

Simple and practical technologies and innovations exist, which need to be disseminated and scaled up to minimize losses. For instance, at the farm level, farmers can reduce their losses through proper practices such as timely harvesting, proper drying, maintenance of storage hygiene, grain treatment and employment of better processing and transportation techniques. Use of metal/plastic silos and hermetic bags has been shown to significantly reduce losses from pests.

Both the national and county governments need to also ensure better transport infrastructure; promote good on-farm and off-farm produce handling and management practices through extension service provision and warehouse receipt initiatives; promotion of use of effective storage and processing facilities to ensure minimal losses such as well calibrated and operational driers; and ensuring proper pest and disease control mechanisms in the production and marketing systems.

Appropriate policies to address maize market imperfections and risks associated with climate change and variability, including price uncertainty will also aid in creating right incentives that will promote provision and accessibility to affordable and scalable solutions to the problem of post-harvest losses.

'Seed funding': How more billionaires can help end world hunger

By Claudia Sadoff

A recent Twitter conversation between the UN's David Beasley and Tesla's Elon Musk has shown that hunger is deceptively complex. There is a crucial difference between acute hunger, caused by shocks like war or natural disasters, and chronic hunger, which occurs when agricultural production (and distribution) fails to keep pace with threats such as soil degradation, erratic rainfall, or heatwaves, or when poverty renders food unaffordable.

This means that ending hunger requires both rapid response efforts during crises and sustained investment to protect our future food supply over the long term. Philanthropists like Mr. Musk who seek to "solve world hunger" should also be encouraged to tackle chronic hunger, as this offers long-term, systemic solutions–much like equity in a business that keeps paying dividends year after year.

A visionary philanthropic opportunity would be the creation of an endowment to support the 11 genebanks held as international public goods by CGIAR, securing in perpetuity the agrobiodiversity we need to feed the world.

Genebanks, which are repositories for genetic material, represent the biological foundation of global food systems, past, present, and future. They are the equivalent of our agricultural intellectual property, and they essentially offer open-source, patent-free "code" for crop breeders anywhere in the world–or potentially other planets–to develop varieties that are more resilient and nutritious and need less water and land.

The genebanks, which are spread over five continents and include a genetic library that survived the war in Syria, contain the most comprehensive back catalog of crop traits and their original or wild relatives. They also form a network that sends duplicate samples to the Doomsday Vault buried in the permafrost on Svalbard island near the North Pole.

As growing conditions change more rapidly under climate change, it is in the trove of genetic material in genebanks that scientists stand to find the traits that could climate-proof and shock-proof food supplies by

Elon Musk, Tesla CEO

David Beasley, UN

incorporating them into new crop varieties–overcoming many of the barriers to fighting malnutrition and hunger around the world.

Within these genebanks, researchers have already identified a gene in wild potatoes that could help breed modern varieties to withstand late blight, the world's most damaging disease for potato crops.

Eliminating losses caused by crop disease would immediately generate more food, income, and opportunities to reduce chronic hunger without needing more land, resources, or food aid.

The potential for genetic gains through crop breeding is not limited to disease resistance. Identifying and combining traits that allow farmers to sow rice seeds directly in the ground–rather than transplanting them in flooded fields–can reduce the amount of water needed for rice production, which eases the burden on smallholder farmers and safeguards a staple crop against water shortages. Such varieties are currently being tested across South Asia and Africa.

> While neither money nor research alone will solve hunger, they can catalyze systematic change on a global scale and significantly reduce the number of people who are starving or chronically malnourished.

The possibilities for better crops to do the heavy lifting against hunger are endless: saline-tolerant rice that withstands more extreme and frequent floods, drought-resistant maize and wheat that secures food amid water scarcity, and faster-growing, early-maturing varieties that increase the growing season for those who depend on agriculture for their livelihoods.

In short, genebanks may just be the exact kind of transformative investment that entrepreneurs like Elon Musk could get behind if they are serious about contributing to the fight against world hunger. These resources are currently funded on an annual basis by generous, committed donors who do not have the scale of resources to fund an endowment. Long-term funding securing the assets' survival in perpetuity would accelerate the rate and equity of innovation available–"seed funding" at its most literal and important.

While neither money nor research alone will "solve" hunger, they can catalyze systematic change on a global scale and significantly reduce the number of people who are starving or chronically malnourished. As a result, those currently at most risk from short-term food crises will also have a stronger starting position and be better placed to cope with temporary food shortages.

Dr. Claudia Sadoff is the managing director for research delivery and impact at CGIAR, the largest publicly funded agricultural research institution in the world.

A Looming Bread Basket Failure

These are the two basic ingredients for successful agriculture: healthy soils and strong performing seeds.

The world finds itself facing the first severe bread basket failure of the 21st century. It has not been brought about by climate change, as most researchers and practitioners would have predicted. We are facing a food crisis that has been triggered by the conflict between Russia and Ukraine, two countries that together account for about 34 percent of the wheat traded annually.

The prospect of a breadbasket failure in the Black Sea region is pushing the prices of commodities to record highs. Russia is also the leading exporter of fertilizer globally and an important fuel supplier, both key inputs for agricultural production. The uncertainty associated with trade restrictions is causing havoc in food-insecure countries and regions that were already worn out by the economic slowdown caused by the pandemic.
Africa and the Middle East are ill-prepared to deal with the crisis but there are at least 35 countries, only in Africa, that source most of their wheat from Ukraine. As grain stocks fall, the effects of this conflict will reverberate in other countries and regions of the world, including North America. The global outlook for 2022 does not look good at all. There is an urgent need for bold answers to the global food crisis that is already here.

In the short term, governments and development agencies or programs will have to advocate for open markets and to adjust global food supply chains. In the longer run, there has to be a global food system transformation that shifts the focus of food production and consumption from efficiency to resilience, and from productivity to adaptation. In the case of basic grains, like maize and wheat, this transformation needs to take place in farms of all sizes and shapes, in breadbasket regions but also in food-dependent countries.

More than before, food growers will want to cut costs to maintain their profits.

Economic incentives can have important benefits for the environment. Commercial farming should make an optimal use of inputs, particularly water and fertilizer. Drip irrigation, remote sensing technologies and conservation and agriculture-based sustainable intensification practices are some of the technologies that farmers can use to grow food in a hotter, drier and more expensive world.

For smallholder farmers, the high costs and risks associated with innovation remain the challenge. It is not easy to phase out conventional practices, such as burns, that deplete natural resources if the risk perception of a crop failure is too high. For that reason, technical assistance, capacity building and collective organization are essential drivers of change in small-scale farming units and communities.

In addition to technologies and training, the farmers of the world need publicly funded research that continuously develops, tests and adapts new, more sustainable farming methods and improved, high-yielding and climate-resilient seeds. These are the two basic ingredients for successful agriculture: healthy soils and strong performing seeds. Both factors are essential for sustainable farming systems that are, in turn, the most solid foundation for a peaceful and prosperous world. Are you ready to do your part together with us?

Bram Govaerts is Director General and CEO at CIMMYT. He is an international authority in maize and wheat cropping systems who works for a successful transition to sustainable intensification of small-scale farming in Africa, Asia and Latin America. Govaerts advises public, private and social organizations worldwide and is an active member of research groups and programs including the Sustainable Development Solutions Network, the Knowledge Systems for Sustainability platform, the A. D. White Professor-at-Large program at Cornell University, and the American Society of Agronomy.

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Protecting Plant Health for Food and Nutritional Security

Global networks present unified and transdisciplinary strategy to protect key crops from devastating pests and diseases.

Mr. B.M. Prasanna

By B.M. Prasanna

Robust and resilient agrifood systems begin with healthy crops. Without healthy crops the food security and livelihoods of millions of resource-constrained smallholder famers in low- and middle-income countries would be in jeopardy. Yet, climate change and globalization are exacerbating the occurrence and spread of devastating insect-pests and pathogens.

Each year, plant diseases cost the global economy an estimated $220 billion — and invasive insect-pests at least $70 billion more. In addition, mycotoxins such as aflatoxins pose serious threats to the health and wellbeing of consumers. Consumption of mycotoxin-contaminated food can cause acute illness, and has been associated with increased risk of certain cancers and immune deficiency syndromes.

Effective plant health management requires holistic approaches that strengthen global and local surveillance and monitoring capacities, and mitigate negative impacts through rapid, robust responses to outbreaks with ecologically friendly, socially-inclusive and sustainable management approaches.

Over the decades, CGIAR has built a strong foundation for fostering holistic plant health protection efforts through its global network of Germplasm Health Units, as well as pathbreaking rapid-response efforts to novel transboundary threats to several important crops, including maize, wheat, rice, bananas, cassava, potatoes and grain legumes.

On May 12, 2022, CGIAR launched the Plant Health and Rapid Response to Protect Food Security and Livelihoods Initiative (Plant Health Initiative). It presents a unified and transdisciplinary strategy to protect key crops — including cereals, legumes, roots, tubers, bananas and vegetables — from devastating pests and diseases, as well as mycotoxin contamination. CGIAR Centers will pursue this critical work together with national, regional and international partner institutions engaged in plant health management.

A comprehensive strategy

Prevention. When and where possible, prevention is always preferable to racing to find a cure. Reactive approaches, followed by most institutions and countries, generally focus on containment and management actions after a pest outbreak, especially pesticide use. These approaches may have paid off in the short- and medium-term, but they are not sustainable long-term. It has become imperative to take proactive actions on transboundary pest management through globally coordinated surveillance, diagnostics and deployment of plant health solutions, as well as dynamic communications and data sharing.

To this end, under this Initiative CGIAR will produce a diagnostics and surveillance toolbox. It will include low-cost and robust assays, genomics- and bioinformatics-based tools for pathogen diagnosis and diversity assessment, as well as information and communications technologies for real-time data collection and crowdsourcing.

This will be complemented by the development of interoperable databases, epidemiological and risk assessment models, and evidence-based guidance frameworks for prioritizing biosecurity measures and rapid response efforts to high-risk insect-pests and diseases.

Adoption of integrated approaches.

The goal of integrated pest and disease management is to economically suppress pest populations using techniques that support healthy crops. An effective management strategy will judiciously use an array of appropriate approaches, including clean seed systems, host-plant resistance, biological control, cultural control and the use of environmentally safer pesticides to protect crops from economic injury without adversely impacting the environment.

Through the Plant Health Initiative, CGIAR will promote system-based solutions using ecofriendly integrated pest and disease management innovation packages to effectively mitigate the impact of major insect-pests and diseases affecting crop plants. It will also implement innovative pre- and post-harvest mycotoxin management tools and processes.

Integrating people's mindsets. The lack of gender and social perspectives in plant health surveillance, technology development, access to extension services and impact evaluation is a major challenge in plant health management. To address this, CGIAR will prioritize interdisciplinary data collection and impact evaluation methods to identify context-specific social and gender related constraints, opportunities and needs, as well as generate evidence-based recommendations for policy makers and stakeholders.

Interface with global and regional Initiatives. The Plant Health Initiative will build on the critical, often pioneering work of CGIAR. It will also work closely with other CGIAR global initiatives — including Accelerated Breeding, Seed Equal, Excellence in Agronomy and Harnessing Equality for Resilience in Agrifood Systems — and Regional Integrated Initiatives. Together, this network will help support CGIAR's work towards developing and deploying improved varieties with insect-pest and disease resistance, coupled with context-sensitive, sustainable agronomic practices, in a gender- and socially-inclusive manner.

Seeds

Targeting localized priorities with strategic partnerships

Effective plant health monitoring and rapid response efforts rely on the quality of cooperation and communication among relevant partner institutions. In this Initiative, CGIAR places special emphasis on developing and strengthening regional and international networks, and building the capacity of local institutions. It will enable globally and regionally coordinated responses by low- and middle-income countries to existing and emerging biotic threats.

To this end, CGIAR will work closely with an array of stakeholders, including national plant protection organizations, national agricultural research and extension systems, advanced research institutions, academia, private sector, and phytosanitary coordination networks.

The geographic focus of interventions under this Initiative will be primarily low- and middle-income countries in Latin America, South and Southeast Asia, and sub-Saharan Africa.

Coupled with CGIAR's commitment to engaging, mobilizing and empowering stakeholders at various scales across the globe, the Plant Health Initiative represents an enormous step towards integrating people's mindsets, capacities and needs towards holistic and sustainable plant health management. It will ultimately protect the food and nutritional security and livelihoods of millions of smallholders and their families.

10 Agricultural Strategies to Increase Income

Farming is tough as farmers are variables such as favourable weather conditions like the right amount of rain at the right time of the year. This stimulates weed growth that needs to be killed to plant the grains without compromising the nutrients they get from the soil. The rain needs to be regular throughout the growing season, and then they need good sunny days to complete the growing stage.

During this stage, good rains are again required, and then again nice sunny days to complete the process of ripening the harvest during. With so many variables involved, the entire process is risky.

The Russian Federation's invasion of Ukraine and the war have resulted in destruction, displacement of people, and economic havoc. The economic consequences of the war are worldwide. Ukraine is a major oilseed and grain exporter. Hence the prospect of a reduced supply of grains and oilseed to the world market has resulted in a sharp increase in its price.

The price of fossil fuels has also risen sharply. The war is surely impacting the agricultural sector and increasing the production cost. However, the output price will also increase; hence the net impact on producers remains uncertain.

A few modifications in agricultural strategy are a great way to boost income and grow your profit margins.

1. Plant different crops

Farmers sometimes fall into the rut of relying on the same crop type year after year. This increases the risk of failure if the crops do not grow well. Instead of relying on one variety of plantations, planting different crops can ensure that you have a backup option to fall on. Select plants that can be sold off in your local community for a profit.

2. Animal husbandry

Animal husbandry is an excellent second source of income for farmers, and it is also a reliable income source. Rearing animals like sheep can be really profitable for farmers.

Whereas the average dairy farm could see a net margin per ha and income level in 2022 broadly in line with the 2021 figure. Dairy farming is a great option to consider, as it does not have as many hurdles as the plantation.

On the other hand, the average gross margin on cattle finishing farms in 2022 is forecast to be similar to 2021 due to the farms in the top-third of profitability.

3. Lease advanced machinery

The better use of machinery means less labour involvement. This also helps save time, which means you can increase crop production and increase your income. If you cannot afford the cost of the machinery, then lease it.

4. Shift towards high-value crops

High-value crops provide higher net returns per hectare to the farmer than high-yielding rice. Hence, shifting your production towards these crops can help automatically increase your income.

You also need to keep in mind the local eating habits to understand if what you yield will sell quickly.

5.
Increase cropping intensity

Cropping intensity is the number of times a crop is planted per year in a given agricultural area. It is the ratio of effective crop area harvested to the physical area. The greater number of times you can plant the crop, it equals the increase in production, hence income. This means never letting your field lie idle.

6. Lease the field

If by any chance a part of your field is idle or you are not planting crops in a particular season, instead of letting the land stand idle, lease it to someone willing for a few months. This will become a steady source of income as the idle land also is not helping you raise your income.

7. Reducing the cost of cultivation

Many farmers do not realize this till it is too late. They overuse fertilizers hoping that increased use of them will increase the yield. This is not just untrue but also risky as it increases the risk of diseases in crops. For example, nitrogen fertilizer is essential in rice production and needs to be applied several times during the growing season to ensure that enough of it is supplied during the critical growth stage.

Once you learn how much fertilizer is needed by learning the leaf colour chart to determine the amount of nutrients required by the plants, it reduces the cost of fertilizer and also saves the plant itself.

8. Reducing post-harvest losses

Post-harvest losses can be one of the major yield losses, as the farmer loses time, money, and all the hard work that had been put into farming for months. In some cases, the losses can rise up to 80% of the full harvested crop; hence you need to plan the storage carefully.

Use pesticides to protect the crop from pests and ensure that the moisture in the storage area is at optimum levels that can reduce the damage in post-harvest storage.

9. By increasing yield

Increasing yield is one of the main things that can help increase any farmer's income. There are many ways you can do this though. You can start by planting disease-resistant plant varieties so that they can withstand diseases and do not cause any loss.

You can also choose a high-yielding crop or the varieties of crop that can do particularly well in the soil or the environmental conditions, which can create a huge impact on the yield.

The duration of the planted crop is also an important factor to consider. If you live in a region where there is less water availability, then planting a crop that needs a longer duration may not be suitable. You need to choose a fast-growing crop instead.

Do not forget to overlook simple issues such as weed removal, as it can cause yield loss, and yet many farmers forget all about it.

Application of nutrients and pesticides should also be done at optimum periods. Sowing and harvesting are non-monetary inputs that are really important and need to be done at an optimum time period.
Also, the provision of timely irrigation is essential that helps reduce the period of crops and improves the yield.

10. By increasing knowledge

It is never too late to learn something new. With new technology emerging that can help farmers, they should always indulge in keeping themselves updated.

There are tonnes of content that they can read online to gain more knowledge in this field. Remember to rely on reliable sources.

The bottom line:
Several factors impact the price of the harvest, such as environmental factors like droughts, floods, and fires, which have a great impact on their income.

The farmer may be working really hard, but their income is determined by weather, environment, and global commodity prices. The global production of a crop determines global commodity prices. If it is high, then the prices can go very low. With so many variables in such a competing market, it is tough to grow a farmer's income. But with, the proper knowledge and application of it, can be beneficial for him in the long run.

Regenerative agriculture for soil health

Farming system harnesses the power of biology to rebuild soil organic matter, diversify crop systems, and improve water retention and nutrient uptake.

South Asia was the epicenter of the Green Revolution, a historic era of agricultural innovation that fed billions of people on the brink of famine.

Yet despite the indisputably positive nutritional and developmental impacts of the Green Revolution of the 1960s, the era of innovation also led to the widespread use of farming practices—like intensive tilling, monoculture, removal and burning of crop residues, and over-use of synthetic fertilizer—that have a deleterious effect on the soil and cause off-site ecological harm. Excess pumping of irrigation water over decades has dried out the region's chief aquifer.

Global woes illustrate the environmental costs of intensive food production to feed our densely-populated planet. Currently, one billion hectares of land worldwide suffers from degraded soils.

The International Maize and Wheat Improvement Center (CIMMYT) works with two of the world's most widely cultivated and consumed cereal crops. To grow enough of these staple foods to feed the world, a second Green Revolution is needed: one that avoids the mistakes of the past, regenerates degraded land and reboots biodiversity in farm areas.

It is important to promote sustainable agricultural practices for maize- and wheat-based farming systems. In the following Q&A, we discuss regenerative agriculture: integrated farming and grazing practices intended to rebuild soil organic matter and restore degraded soil biodiversity.

What major components or practices are part of regenerative agriculture?

Regenerative agriculture is a comprehensive system of farming that harnesses the power of soil biology to

rebuild soil organic matter, diversify crop systems, and improve water retention and nutrient uptake. The depletion of biodiversity, degradation of soil health, warming, and drier weather in farm areas have necessitated a reversal in agriculture from "degeneration to regeneration."

The practices address food and nutritional security challenges while protecting natural resources and lowering agriculture's environmental footprint, in line with the United Nations Sustainable Development Goals. CIMMYT has worked for years to research and promote conservation agriculture, which contributes to the aims of regenerative agriculture, and is already practiced on more than 200 million hectares globally — 15% of all cropland — and is expanding at a rate of 10.5 million hectares per year.

What are the potential roles of major food crops — maize, rice, and wheat — in regenerative agriculture systems?

Regenerative agriculture is "crop neutral;" that is, it is applicable to almost all crops and farming systems. The world's rice, wheat, and maize crops have an enormous physical and ecological footprint on land and natural resources, but play a critical role in food and nutrition security. Considering that anthropogenic climate change has reduced the global agricultural total factor productivity by about 21% in the past six decades, applying regenerative agriculture approaches to these systems represents a momentous contribution toward sustainable farming under increasing climatic risks.

What elements or approaches of regenerative agriculture are applicable in Kenya and how can they be applied?

Regenerative practices for maize and wheat systems in Kenya include no-tillage, crop residue recycling, legume inter-cropping and cover crops, crop diversification, integrated nutrient management, and precision water management.

The potential area of adoption for regenerative agriculture in Kenya covers at least 50 million hectares across a diversity of cropping systems and agroecologies — including irrigated, rainfed, and arid farmlands — and can be approached through appropriate targeting, investments, knowledge and capacity enhancement, and enabling policies.

In the breadbasket regions, regenerative agriculture can help address the aforementioned second-generation problems of the Green Revolution, as well as contributing to the Kenya's government's Soil Health and its COP26 commitments.

In order to get regenerative agriculture off the ground in Kenya, who will be involved?

Adapting and applying regenerative agriculture's portfolio of practices will require the participation of all stakeholders associated with farming. Application of these principles is location- and situation-specific, so researchers, extension functionaries, value chain actors, philanthropists, environmentalists, NGOs, farmers, and policy planners all have a role to play in the impact pathway.

CIMMYT, public and private programs and agencies, and farmers themselves have been developing, refining, and scaling out conservation agriculture-based regenerative agriculture practices. CIMMYT will continue to play a key role in mainstreaming regenerative agriculture in local, national, and regional development plans through science-based policy and capacity development.

Farmers constitute a strong economic and political force. How can they be brought on board to practice regenerative agriculture, which could be more costly and knowledge-intensive than their current practices?

We need to pursue business "unusual" and harness the potential opportunities of regenerative agriculture to sequester soil carbon and reduce greenhouse gas emissions. Regenerative agriculture practices can offer farmers additional income and certainly create a "pull factor" for their adoption, something that has already started and will constitute a strong business case. For example, innovative business models give farmers an opportunity to trade ecosystem services and carbon credits through repurposing subsidies and developing carbon markets for private sectors.

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