CEREALS

The leading journal for field crops

October - December 2023

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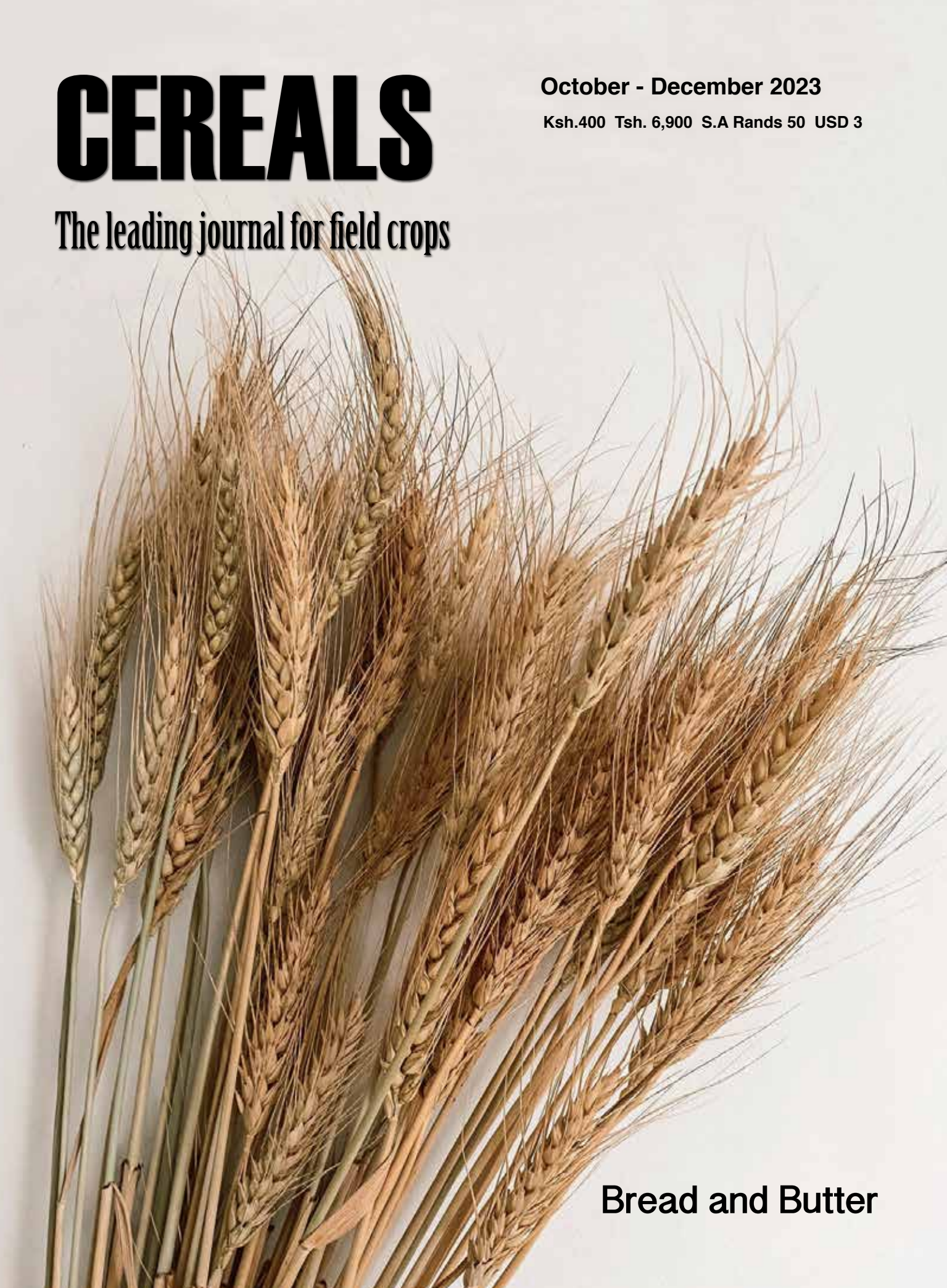

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2024

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Sustainable Agriculture and Economic Growth

Agriculture and trade are interconnected and directly influence the performance of other economic sectors. There's need to move beyond subsistence agriculture and to emphasize competitiveness, productivity, efficiency, value addition, manufacturing, and trade.

Cereals

October - December 2023

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Let us Support Our Farmers

Bye.. 2023. Allow me to thank all our farmers for whom we worked together this year hence assured of satiating our most basic need-'Food.' But coming to the predicament of most farmers in the remote villages of our country, it is undeniable that they are underpaid for the efforts they put into their work. They earn their livelihood by providing food for the rest of the population, but even today, most farmers' families do not have the basic amenities like electricity, education, healthcare facilities, right at their hands. Even the modern resources or inputs for sustainable farming are still not available to them due to their remote location.

Year round, we have highlighted how input suppliers are doubling their efforts to ensure the newest innovations get to the farmer. When will we ever celebrate the government extension officers or national research institutions getting down to the farmer with their innovations? Since our farmers work hard to provide food for us, their interests and well-being must always be kept at the forefront.

Masila Kanyingi
Editor

Tarzec™ 320WG: The Next Generation of Weed Control

Mr. Anampiu Kithinji, Business Director WESCA

It was pomp and dance at a Nanyuki hotel as wheat growers welcomed the entry of a totally unique post-emergence Herbicide for the control of grasses and broad leaf weeds on wheat, Tarzec™ 320 WG. The launch came with an almost audio-recorded oratory of the Corteva Agriscience Marketing Campaign Manager, Mr. Innocent Oeri not previously heard before on the slopes of Mt. Kenya. Co-ordinating well with seasoned Francis Karanja, the Corteva Agriscience Sales Manager ESCA, they touched the hearts of growers who will definitely add it to their spray programs.

Though seasoned in covering launches, I had never seen such an interactive session as growers engaged the able Corteva technical team Led by Mr. Anampiu Kithinji, Business Director WESCA, Stephen Nderitu, Territory Sales Representative and Joan Mbuva, Marketing Specialist. The team was also supported by knowledgeable distributors among them David Ndegwa of Grebe, Brenda Muthoni of Sunrise and Mr. Stanley Maina, a farmer and a freelance consultant specialized in wheat.

In a more theatrical way, Mr. Oeri said, "In today's ever changing environment- with constantly shifting social-economic, environmental and market priorities, every grower would vote for a product which ensures effective weed management, cost competitive, with minimal environmental impact, crop tolerance and good compatibility. In addition, it should lead to more vigorous, healthier and higher yielding crops".

Tarzec™ 320 WG is a broad-spectrum wheat herbicide with no carry over, with better flexibility on timing and weather conditions, and has a unique mode of action for control of a wide range of broadleaf and some grass weeds in wheat. This was said by Mr. Innocent Oeri while addressing farmers during the launch. Mr. Oeri told farmers that Tarzec™ 320 WG is a systemic herbicide mainly absorbed through leaves, and shoots but also by roots of plants. It is translocated through the phloem and xylem and accumulates in the meristematic tissue. Tarzec ™ 320 WG has ArylexTM active as the driver molecule.

Arylex™ active is a synthetic auxin herbicide. Treatment with Arylex™ active mimics the effects of a persistent high dose of the natural plant hormone auxin causing overstimulation of specific auxin-regulated genes. Like other triazolopyrimidines, pyroxsulam inhibits acetolactate synthase (ALS), which is an essential enzyme in branched-chain amino acid biosynthesis. These include the essential amino acids valine, leucine and isoleucine. Inhibition of amino acid production subsequently inhibits cell division and causes death in susceptible plants.

Tarzec™ 320 WG herbicide Technical Attributes include

- Cross Spectrum of Efficacy
- Faster Kill of Broadleaf Weeds
- Wide Window of Application
- Ease of Use
- Low Use Rate
- Following Crop Flexibility

Spectrum of activity

Mr. Stephen Nderitu took the growers through a variety of grasses and weeds. He said "it's highly evident that cereal farmers are facing extreme challenges in managing tough weeds like Foxtail, love grass (setaria sp), Wild Oat (Avena fatua), & Crabgrass (Digataria Sangunalis) with existing options. In addition, they are also facing challenges of Broad Leaf Weeds such as Billy goat (Ageratum conzydes), Pigweed (Amaranthus hybrindus), Black Jack (Bidens Pilosa) etc. With Tarzec™ 320 WG superior level of control, and unmatched application flexibility, the Corteva Agriscience team is very excited about the role Tarzec™ 320 WG will play to enable farmers to restore effective, efficient and sustainable weed control programs."

Application of Tarzec™ 320 WG must be when the wheat crop is at the early tillering stage to two nodes stage (BBCH 12-32). The weeds should be actively growing at the time of application. Tarzec™ 320 WG will provide post-emergence activity on

broadleaf weeds that are at 2-6 leaves and grasses that are at 2 Leaves to the early tillering stage. Tarzec™ 320 WG may be applied by a knapsack or tractor-mounted sprayer as a broadcast foliar application. Spray in dilution of 200 L of water/Ha.

Formulation Attribute

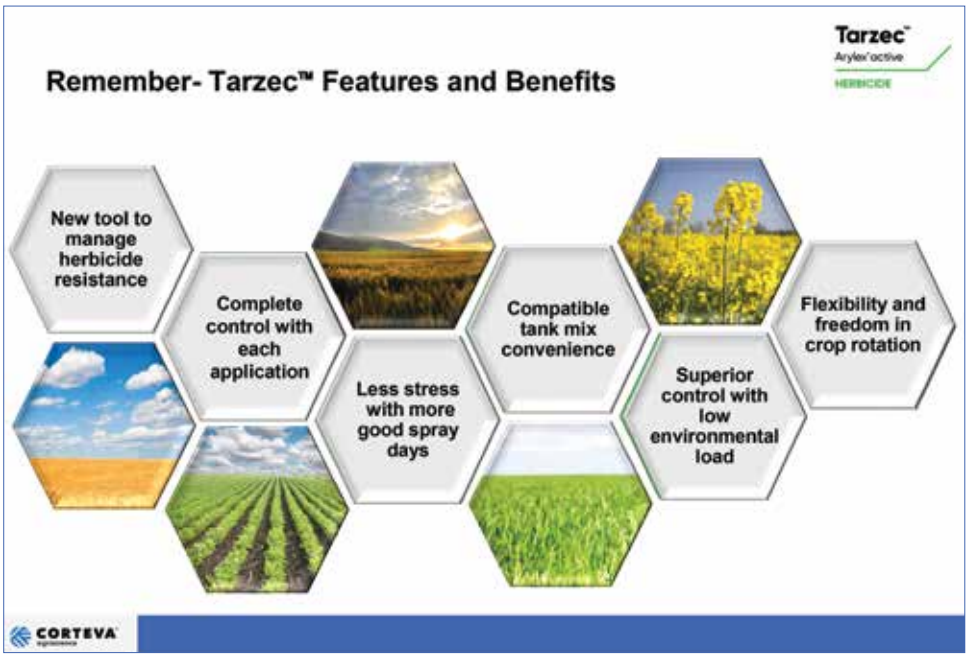
It is a safe formulation compatible with wide range of tank-mix partners and Adjuvants, and easy to measure and easy to use. Tarzec™ 320 WG has a rapid dispersion in cold water and active suspension in water. It has no sedimentation, less packaging left to destroy later and is dust-free. The product has a rainfastness of 1-4 hours after application.

Managing Resistance

Tarzec™ 320 WG offers flexibility and freedom in crop rotation. Where possible, rotate using Tarzec™ 320 WG herbicide or other ALS herbicides with different herbicide groups that control the same weeds. Farmers are advised to use recommended rates to maximize control of high-risk/difficult-to-control weeds and follow label statements concerning rates, volumes and timing of application. Tarzec™ 320 WG should only be applied ONCE per season and farmers are advised not to over-rely on a single herbicide mode of action. They should consider the use of cultural control methods when possible

Remarks

Mr. Francis Karanja took growers through other Corteva Agriscience products for both Cereals and Horticulture among them Equation Pro for control of Downy and Blight. “This will save you 18 days of Sprays per season”, he said. Corteva Agriscience boasts of Uphold™ 360 SC, one of the few products that kills the eggs of caterpillars and other stages of their life cycle. He also took growers through Fidelity 400 WG, a contact and systemic insecticide with a duo mode of action for the control of a wide range of sap-sucking and chewing insects.



Mr. Anampiu concluded by re-echoing the commitment of Corteva Agriscience to consistently bring sustainable and affordable crop protection products to Kenyan farmers and the entire Eastern Africa region at large. He assured farmers of their commitment to be the leader of innovative sustainable solutions for farmers worldwide, today and tomorrow.

Mr. David Ndegwa of Grebe the National distributor of Tarzec™ 320 WG said the launch could not have come at a more opportune moment than this for the region when growers are planting. Growers yearn to obtain quality products that can be integrated into their programs; to meet the ever-stringent market requirements on safety and environmental protection, amongst others. He commended Corteva Agriscience for working hard in this area to provide growers with successful and efficient products.

In his speech, Mr. Elly Mutai, a farmer from Kisima Area of Timau thanked Corteva Agriscience for keeping abreast of the market demand, whilst maintaining the highest standards of operation demanded by the international standards. “We keep a hawk’s eye on our products as guided by the stringent international standards and all the products lined up for you have been able to pass them,” he said. Tarzec™ 320 WG entry into the area offers growers additional choice of herbicides.

In his final remarks, Mr. Wachira, another farmer from Nyeri said, “Today marks an important milestone for Corteva’s history and commitment to farmers. This shows you strive to bring benefits not just products, you just don’t sell products but provide solutions to enhance productivity per unit area. Tarzec™ 320 WG is just not a new product but a package of innovation to meet the ever-changing dynamics of crop protection”.

Most of those interviewed by this quarterly magazine represented a cross-section of people from all sub-sectors of the agriculture business and they believed Tarzec™ 320 WG would be of major commercial advantage to them.

Summing up the launch, Mr. Anampiu said, “Our desire is to use our technical capacity and capabilities to introduce quality products like Tarzec ™ 320 WG. We also endeavour to offer you professional and ethical advisory services in crop protection. It is our high expectation that we will live up to your expectations as a world-class agricultural solutions company”.

TARZEC™ 320 WG

Arylex Active + Pyroxsulam

Arylex™ active is a new herbicide for the control of broadleaf weeds with utility in multiple crops. Arylex™ is an innovative low-dose growth regulator herbicide for use in mixtures with other Corteva Agriscience proprietary herbicides creating a wide spectrum of products customized for specific geographies.

Pyroxsulam is a new sulfonamide herbicide that provides broad spectrum postemergence annual grass and broadleaf weed control in cereals.

Key Attributes

- Effective post-emergence control of many common and economically damaging broadleaf weeds in wheat.
- Consistent weed control across variable climatic conditions (cold and dry conditions) allows for flexibility of application.
- Low use rates resulting in low environmental load of the herbicide.
- Alternative mode of action to help manage resistant weed biotypes.
- Rapid degradation in soil and plant tissues allowing for crop rotation flexibility, favorable environmental and toxicological profile.

TARZEC™ 320 WG

Arylex™ active

HERBICIDE

Post – Emergence Herbicide for the control of Grasses & Broad leaf weeds on Wheat

Active Ingredient:

Arylex™ active 69.5 g/Kg & Pyroxsulam 250g/Kg

Application Rate:

90g/ha, 9 g/20l

PHI: 71 Days

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Is it Bread and Butter in Kenya's Wheat Basket?

Most wheat producers have their total disease management program in place once the seed is in the ground. By that time, decisions have been made relative to crop rotation, tillage/ seedbed preparation, variety selection, seed quality, seed treatment, planting date, seeding method, seeding rate, and soil fertility. Individually and collectively, these decisions can play an important role in influencing which diseases develop, 'their severity, and their effect on crop yield and weight.

The giant New Holland machine rips through the plantation, raising blinding dust in its wake. After one long trip amid the humming of the engine, it deposits grain into a waiting truck before embarking on a virgin set of rows. Tens, perhaps hundreds of combine harvesters have pitched tent, slowing traffic on the Bomet-Nairobi road and bringing roaring business in Narok and other trading centres.

Fast Track eight to nine months later and the scenes are completely different. The sight of farmers around drying wheat on the ground with agents haggling over price and quality is a reminder of how farmers take advantage of the plentiful sunshine to cut post-harvest costs. Makeshift canvas driers line both sides of the Maai Mahiu-Narok-Bomet highway, a section of the Northern Corridor transport system that creates a shorter link to western Kenya.

Wheat Growing

Narok is Kenya's undisputed wheat basket, producing slightly over 250,000MT which is around 70% of the national wheat output in any given year. Wheat is the second most important cereal grain in Kenya after maize though rice is also going up. Wheat farming in Narok is largely done for commercial purposes on a large-scale. The region produces the hard variety wheat which is the best for baking quality, making it popular with millers.

Scientists at the Kenya agricultural Livestock and Research Organization (Kalro) are instrumental in coming up with varieties that are stress tolerant disease resistant. In addition they have higher yields, are drought resistant, no lodging and have tillering capability. The crop is grown both by small scale and large scale farmers. The fields are ploughed by tractors during the dry season. This is followed by several harrowing with a round of non-selective herbicides.

Conditions Favoring Wheat Farming in Narok

Gentle slope

The land where wheat is grown is gently or fairly level and this has allowed for mechanization. Additionally, most of the farms have not been sub-divided making it easy for machine cultivation.

Altitude

The growing areas have a high altitude ranging from 1500 – 2900 mm. This reduces the incidence of diseases.

Moderate rainfall

The wheat growing areas receive moderate rainfall ranging from 500 mm to 1,200 mm which promotes the growth of wheat.

Warm temperature

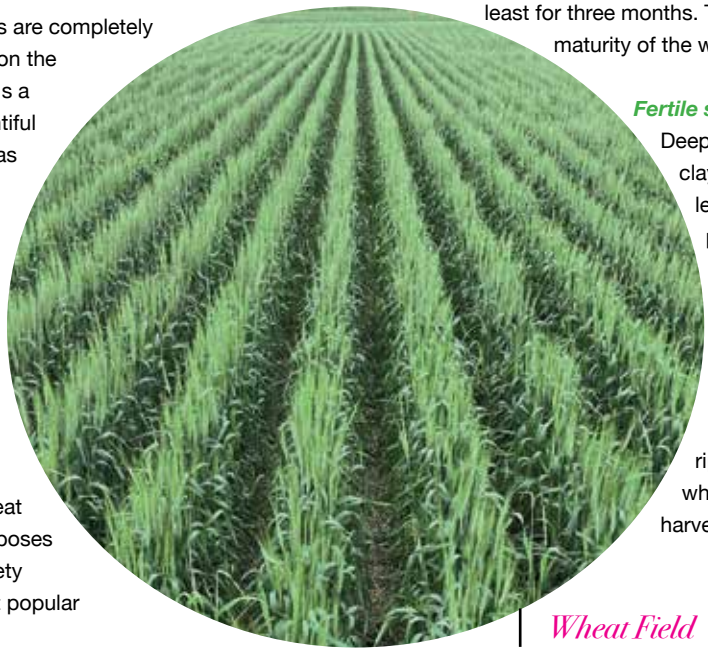
Warm temperatures of 150C to 200C at least for three months. This enables maturity of the wheat.

Fertile soils

Deep fertile black clay soils which lead to high production.

Dry spell

Warm dry sunny spell which enhances ripening of wheat and harvesting.



Wheat Field

Crop Production

Wheat is machine intense farming with most of the work done mechanically. The area has one main season running from November to July. Land preparation is mechanically done either by ploughing or tilling. Control of weeds is done manually by small scale farmers while large scale farmers use modern scientific methods e.g. application of herbicides.

Integrated weed management practices; includes scouting, historical information related to other mechanical, cultural, biological and other chemical control practices are advisable.

An integrated approach to weed management, whether in crop or non-crop land, is an important environmental and economic consideration. Multiple management practices can be used in an integrated plan to prevent or delay the development of herbicide resistant weed populations.

Farmers should Monitor treated weed populations for resistance development. Prevent movement of resistant weed seeds to other fields by cleaning, harvesting and tillage equipment and clean planting seed. Use of certified seed greatly minimize the introduction of weed seeds from herbicide- resistant biotypes.

Farmers are advised to start with a clean field and control weeds early by using a burn-down treatment or tillage combined with a pre-emergence herbicides. After planting, farmers apply post emergency herbicides if necessary.

Crop Protection

Wheat farmers rank disease as one of the top factors limiting wheat yields on their farms. Disease management is a key component of high-yielding wheat. Some diseases, must be managed proactively and cannot be controlled once they are established. Other diseases, such as foliar diseases caused by fungi, can be managed by the timely application of foliar fungicides.

Stem rust popularly known as UG99 because of the country it was first discovered (Uganda) and the year it was named has not been, giving farmers a breather. Also referred to as the polio of agriculture, the disease can wipe out up to 70 per cent of the crop. In addition, farmers should also be careful of yellow rust, leaf rust, septoria also known as glume botch, and fusarium (late infection). Other than diseases, insects could also be a menace. The Russian wheat aphids are the main insects though cut worms, caterpillars, wire worms, chaffer grabs can also wipe your wheat.

Disease Management

Most wheat producers have their total disease management program in place once the seed is in the ground. By that time, decisions have been made relative to crop rotation, tillage/ seedbed preparation, variety selection, seed quality, seed treatment, planting date, seeding method, seeding rate, and soil fertility. Individually and collectively, these decisions can play an important role in influencing which diseases develop, their severity, and their effect on crop yield and weight.

Because pre-plant and planting decisions are important in the management of wheat diseases, you need to understand how they affect disease.

Depending on the rainfall pattern, farmers should do a minimum of three to five fungicide sprays. All fungicides must be applied within specific growth-stage. Fungicides provide the greatest benefit when plants are protected from disease between flag leaf emergence and soft dough. The most critical stage is typically from mid head emergence through flowering. This is the period in which fungicide applications are often most beneficial.

Scouting for disease

Scouting for disease is very important for two reasons. Yearly scouting helps you to build an on-farm database that can be used to select appropriate disease management tactics for future crops. Scouting also helps you determine if and when to spray fungicides. Once fields are properly scouted, data can be used to determine disease control options. Course of action should be started only when you are fully armed with up-to-date, accurate information.

Variety selection

Decisions relating to variety selection are, perhaps, the most important decisions in managing diseases.

Every commercially available wheat variety has a unique range of reaction to common diseases. Which and how many varieties

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are planted determines the potential for certain diseases. Failure to consider the implications of variety selection in managing diseases is a costly mistake made by many wheat farmers.

Crop rotation

Crop rotation helps in the management of wheat pathogens that survive between wheat crops in wheat residue. When a crop other than wheat is grown in a field, levels of wheat pathogens decline. This occurs simultaneously as the residue of previous crops deteriorates. Reduced levels of pathogens can translate into reduced disease pressure the next time wheat is produced.

Tillage / Cultivation

Ploughing wheat residue hastens the breakdown of residue that harbors certain disease organisms. This can help reduce levels of take – all and foliar diseases, such as Septoria leaf blotch and tan spot.

Insects Management

Scouting for insect pest is important for two reasons. Yearly scouting helps you build an on-farm database that can be used to select appropriate insect management tactics for future crops. Scouting also helps you determine if and when to spray insecticides. Once fields are properly scouted, data can be used to determine insect control options. Course of action should be started only when you are fully armed with up to date, accurate information.

Decision to apply an insecticide should be based on scouting and the use of threshold. Scheduled or automatic applications of insecticides should be avoided because unnecessary application can be more costly than just the cost of the insecticide. Application of insecticides on an as-needed basis will allow beneficial insects to be preserved which reduces the likelihood of secondary pest out breaks.

Scouting for insects

Depending on when the crop is planted, insect problems vary from non-existent to severe. Identifying the pest and understanding its potential for damage is necessary when selecting appropriate control methods. Each pest does not respond the same way to a given method. Monitor fields at least twice per week. Walk a “V” or “W” pattern through the field and select plants from 12 random locations along the pattern. When plants are still small (up to 10 leaves), examine 6 adjacent plants per location for insects and disease. As plants get larger sample 3 leaves per plant on 6 adjacent plants per location (total of 216 leaves).

Insects cause injury to the leaves, stems, roots, and fruit. The developmental stage of the plant at the time of attack often governs which plant part different insect pests may injure. However, some insects feed specifically on one plant structure; others may feed on several structures. The first step in control is to identify the insect. Most insect problems can be treated as needed if detected early, but no one insecticide will adequately control all the insects that may attack a crop. Scouting for insects is the most efficient way to determine what problems may exist and what action should be taken.

In addition to monitoring for pest insects, some beneficial species exist which should be considered. Several species of predatory and parasitic insects are present in crops. These natural controls are considered especially during early season. Big – eyed bugs, minute pirate bugs, fire ants and Cotesia wasps are four important beneficial insects. The presence of these natural controls may delay the need to treat for bollworms. The use of beneficial insects should be maximized in attempts to reduce production costs.

When the crop is ready for harvesting, the small scale farmers use simple tools e.g. sickles or sharp knives to cut the wheat heads. The cut wheat is threshed dried and winnowed. Large scale farmers use machines mainly combine harvesters.

Migratory bird menace

Recently the crop has also come under attack by the quelea, a migratory bird species that can consume thousands of acres of crop in a week. Each bird consumes 10 grammes a day, and if uninterrupted by farmers who scare them away, nine million birds can decimate 90 tonnes a day.

Quelea: One of the Migratory birds

Farmers need to be more prepared in controlling the migratory birds.

Harvesting and Post harvesting

Many farmers harvest 12 bags from an acre and above with an increment vary. In harvesting, farmers must ensure the dry grain has attained a moisture content close to 14. To be successful

farmers, they must ensure they have their own silos or store where they can fumigate, dust or spray. Thereafter depending on the market price, they can store and wait for better prices.

Challenges Facing Farmers

The productivity of wheat in Narok is under threat due to the following:

Inadequate capital

Generally production is very expensive. Some of the small scale farmers do not have enough capital for the purchase of expensive farm input such as fertilizers, herbicides and hire farm machinery e. g., tractors and combine harvesters. The crop is in some instances affected by pests and diseases can destroy the crop leading to low yields.

Climatic hazards

Narok can be compared to Les Vagas. It is very important for farmers to confirm rain patterns through weather setilites probably in the US or UK. Farmers can also visit weather sites like Accuweather in the internet. Heavy stormy rains during the rainy seasons can destroy the crop by flattening it leading to rotting. Drought before the crop is ready may destroy the entire crop.

Price fluctuation

Price fluctuations on the domestic market leads to losses for the farmers as at times, they are made to sell their produce at very low prices. Kenya is a wheat-deficit country relying on imports to meet the growing demand for the product. Millers take advantage of the deficit and flood the market with imported wheat to lower the local prices to unmanageable levels. Middlemen also can infiltrate the system. To cushion this, farmers can form an association to take care of their interests.

Why the Government should support the farmers

Wheat has benefited the economy of Kenya and can still grow it to higher levels through:

Industrialization

Wheat farming has led to the development of related industries in the growing areas and also in the major urban centres e. g., Nairobi, Eldoret and Nakuru. These are mainly industries that deal in confectionaries. These are not able to feed the country so there is room to grow more.

Infrastructure

Roads have been established in the wheat growing areas to assist in the transportation, this has assisted in the improvement of rural infrastructure.

Saves foreign exchange

All the wheat grown in Kenya is for local consumption. However, the country still has to import some wheat to satisfy her domestic requirements. Wheat farming therefore helps the government to save foreign exchange by reducing the amount of wheat imports.

Employment

Many people have gotten employment through wheat farming directly and indirectly. For example, while some have been employed directly on the wheat farms, others are employed in the related industries e.g. bakeries and other confectionaries.

Source of income

Through wheat fanning, farmers have earned an income directly through the sale of their crops. This has raised their standards of living and helped in alleviating poverty in the country.

Deficit

All said and done Kenyans are far from achieving near self-sufficiency in their essential supply of wheat and bread. The current population of 40 million is increasingly urbanizing and the demand for wheat is estimated at over one million metric tons compared to annual output of 450,000 tons or only 45% percent.

Not much has changed in the past four decades; our national output is fairly much the same as it was in 1969 when the population was 10.9 million and more rural. The population has since then increased over 3.6 times, so we are depending more on imported wheat and using more foreign exchange. The bottom line is that with farmers producing 5.6 kg of wheat per Kenyan today compared to 20.5 kg in 1969, the stress and conflict between farmers and consumers is bound to continue rising.

Last Word

The soil life in Narok is completely depleted and if caution is not taken, we will be nailing the last nail on their coffin. Farmers need to revamp the soils through the right crop rotation. Other than the commonly used maize for rotation, there is need to change to Canola, Sunflower and Garden Peas.

Secondly, farmers must change to conventional or zero till. Chisel plough not disc plough to break the hard pan can also be of help. This will open the soils for good aeration and water infiltration for better sucking of the water by the roots.

Lastly farmers invest millions and forget that their fate can be determined by Kshs. 1,500 for soil testing. Soil Ph and soil solubility tests will determine certain levels of fertilizer and guide on nutrition for a better crop.

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Wheat

Choosing the Right Wheat Variety

By David Jones

Choosing the right wheat variety is one of the most important steps to growing a profitable and reliable wheat crop. Disease resistance, yield, grain quality, sprouting risk, and many other factors should be taken into consideration so that the chances of achieving a high yield and Grade 1 quality with minimal risk and expenditure on inputs. We take a look at the characteristics of some popular varieties, and what to be aware of when growing them in order to give yourself the best chance of a successful crop.

Robin: One of the most consistent performers, and when looked after it is still probably the highest yielding variety – but only if looked after. Four fungicide sprays are always required because of the very poor Stem Rust resistance, and we have noticed that the variety appears to be breaking down to Yellow Rust too.

Generally, Robin is very stiff and does not produce many tillers so does not easily lodge, and grain quality is ok – specific weight is never the best but even with a week of rain at harvest the bushel weight does not drop significantly and Robin rarely sprouts.

Hawk: A very high-yield potential variety but in the field it does tend to be less consistent than other varieties, something we have seen in trials too. Like Robin, Hawk has long since broken down to both Yellow Rust and Stem Rust so needs managing carefully. Grain quality is good and sprouting is rarely an issue, but the straw can often go weak in the mid-stem in a delayed, wet harvest.

Eagle 10: A relatively fast, early maturing variety which is slightly stronger on Stem Rust than Robin and Hawk but very susceptible to Yellow Rust. Eagle 10 has produced some exceptionally good grain and tends not to sprout, but it does lodge badly so be careful not to plant at too high a seed rate.

> *“Eagle 10 has produced some exceptionally good grain and tends not to sprout, but it does lodge badly so be careful not to plant at too high a seed rate.*

Korongo: A white grain wheat which brings with it excellent grain quality and bushel weight but sprouting risk. Do not grow this in a location where there is a risk of rain at harvest as it will punish you. Korongo does thrive in dry seasons and we have seen some of its best results in trials in droughts. Manage the Stem Rust, but also the Fusarium with a well-timed fungicide at early flowering and it does reward you. On strong, fertile shambas it can lodge so be careful of seed rate and topdressing.

Kasuku: A very high-yielding red wheat, but with serious Fusarium weakness and sprouting risk (it behaves more like a white wheat). Kasuku brings some excellent characteristics like lodging resistance and its yield is often similar to Robin. In a way, Robin and Kasuku compliment each other well as they have different strengths and weaknesses, allowing you to balance the risk on big areas of wheat.

Kasuku must be prioritised at harvest because of the sprouting risk, but also because the bushel weight falls far more

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quickly than other varieties in a wet season. We consider it to be moderately resistant to Stem Rust but moderately susceptible to Yellow Rust. High seed rates do tend to pay off with Kasuku.

Njoro 2: Moderately high yields and reasonable grain quality, fairly weak straw but moderately resistant to Stem Rust. Continues to be a very popular variety for its consistency and ease of management.

Mwera: A variety of which nobody seems to know the origins, but extremely popular and understandably so. Mwera combines arguably the best all-round disease resistance with some of the highest yields, proving in trials to be on a similar level to Robin and Kasuku.

The ease of managing this variety (tall but stiff straw, no sprouting) makes this a very appealing variety to farmers. The downside is the low vigour and tillering which makes it a relatively uncompetitive variety against grassweeds. Bushel weight tends to be around average.

Hyrax: A relatively tall and late red wheat. A solid all-round performer with average bushel weight, very good Stem Rust, Yellow Rust, Fusarium and Septoria resistance, and standing ability. Its only weakness is yield, which has been 9% lower than Robin on trials.

Jacana: Moderate yields but very good disease resistance and low sprouting. Another solid variety, let down by generally low specific weights in trials.

Impala: A great white wheat from KALRO. This is quite an exciting variety as it combines excellent grain quality with improved standing ability and much better all-round disease resistance than other white wheats such as Korongo or Brambling.

Rotation with canola

Whilst most farmers are very proficient at planting larger grain seeds such as maize and beans, and even wheat and barley, very small grains such as canola often require a different approach and mindset. Introducing a break-crop into a farm that has grown years of wheat, barley or maize has enormous benefits to profitability, but the crop itself has to make money and this starts with good planning and establishment.

Top tip – canola seeds can be hard to see to check the depth, so put some light wheat grains in the bottom of the hopper on a trial-run so that you can see the depth (they need to be light grains or cleanings so that you can see if they are blowing out of the furrow if the fan speed is too high.

Firstly, the planter should be well maintained; meter rollers all present and in good order, chains oiled and greased, bearings checked and replaced if necessary, and all hoses tightly fixed. Springs and coulter tension to place the seeds in the ground should be set in line with the manufacturer's handbook, and practice runs with seed and fertiliser carried out to check the depth placement – ideally 1-2cm for canola.

Aim for a fine, level, and firm but not compact seedbed. The planter should be able to cover almost all of the seeds and not be bouncing over un-even bumps and holes. Remember that the planter will do some cultivation, but aim for the largest clod of soil to be the size of the palm of your hand, and some fine soil surrounding the seed.

Too fine leads to capping and erosion. -Once calibrated – typically around 2-4 kg/ha for canola – the depth should be regularly checked particularly as soil types change across a field which can lead to the planter going too deep or shallow.

If you are dry planting, check the seed is into dry soil. If you are confident that there is enough moisture, try to keep it by rolling afterwards with a flat roll or a ring roller (this improves seed-to-soil contact too, helping rapid and even germination and will improve the effectiveness of herbicides).

As a general but very good rule, 8kph is as fast as you want to go in most cultivated soils – the more the machine bounces the less seed will actually get to where you want it! If you are driving at 6kph and the planter is still blowing seed out of the ground, you probably need to do another cultivation with the harrows to level the soil.

Pests

Whilst checking for seed depth this is also a great time to scout for Cutworms which can cut the crop off as it tries to emerge. You rarely have much time to react to Cutworm, so many farmers base the decision to spray based on field history and past experience, applying a deltamethrin or lambda-cyhalothrin at or before planting.

David Jones is an Agronomist.

Brome Control in Cereals

It was once said that "A wise person gets more from their enemies than a fool from their friends". If we consider Brome as our enemy and what it is telling us about our farming system, we have a lot to learn.

There are an awful lot of farms that are struggling to grow a crop of wheat or barley because of Brome – and Ryegrass – outcompeting the crop. The options to control these to try and improve the yield and profitability of the crop fall into three categories, but there is, frankly very little good news in the first two.

Brome Grass

Herbicides remain the most obvious, short-term answer for doing something to reduce grass weeds and their effect on the crop. *Pendimethalin* is the most obvious, and while it does not appear to do a great deal it still reliably gives around 50% control of Brome and Ryegrass.

Flufenacet, whilst temporarily unavailable in Kenya does add significantly to *pendimethalin* for Ryegrass (it doesn't do much on Brome) but needs cool and damp conditions to thrive. Certainly not a product for areas below around 2,200m. *Triallate* was very effective, once registered in Kenya as *Avadex*, and tends to be very effective against numerous Brome species in other parts of the world. I wonder if anyone will try to re-register the product here as it is highly effective.

Post-emergence options are limited, not least in barley where no options exist. *Pyroxsulam* has almost completely stopped working on most Brome populations that I see, *Propoxycarbazone* is very variable in its control and can cause significant leaf trapping and stunting *Iodosulfuron* (+/- *mesosulfuron*) is occasionally effective, but once again resistance is very widespread as is the case with all Group B grass weed herbicides. Do not forget that these products are in fact very good growth regulators on wheat and do a lot of harm to the crop; if they are not controlling the weeds then they are doing more harm than good by suppressing the crop.

Non-chemical in-crop measures are limited to creating a more competitive crop with narrow rows and higher seed rates – which brings other problems such as lodging – or going to the other extreme and planting on wide rows to allow an inter-row mechanical weeder. This takes a lot of skill and patience, as well as dry weather, and is still of limited usefulness.

Delaying planting will help by allowing a flush of Brome which can be sprayed off with glyphosate before planting. This will inevitably compromise the crop however, as it will be grain filling later in dryer and warmer conditions, so with high Brome populations this is only really practical if you can switch from a long-rains to a short rains season. Ultimately the answer lies in crop rotation.

Maize lodging

Avoiding Lodging in Cereals

Lodging in cereals is the bending over of the stems near ground level of grain crops. Lodging makes cereal crops very difficult to harvest and can dramatically reduce yield.

By David Jones

Causes of Lodging in Cereals

Lodging in cereals is often caused by inadequate standing power of the crop and other external conditions such a storm damage, soil density, disease, sowing date, overpopulation and seed type. Lodging affects crops such as maize, wheat, rice and other cereals. Reducing lodging in cereal crops is a major goal of agricultural research. As crop varieties and techniques have improved, we are encountering the inevitable problem of lodging in farms. This is indeed a good problem to have, but nonetheless it is still a problem which needs to be addressed.

Management of Crop Lodging

The risk of the crop falling over can however be reduced and almost eliminated by taking sensible steps and planning ahead at the beginning of the season.

It is also worth noting that lodging is worse in cloudier, overcast conditions where gibberellin activity is greatest and internode elongation is greatest.

1. Seed rates. For fertile areas of the field, cut seed rates to 80 seeds/m2 (40kg/ha) for barley and 100 seeds/m2 (50kg/ha) in wheat. The major plus side of this is that you not only save money on seed but this is the most important step you can take to reduce the chances of lodging. The downside is that this is harder to do in practice without variable seed rates, and establishment needs to be really good at these low seed rates to avoid gaps.

2. Seed depth. Aim for 25 to 35mm. Planting too shallow or too deep can compromise crown root development.

3. Nitrogen. Areas that tend to fall over also tend not to respond to topdressing in my experience, so there is a double saving here of greater yield from more crop picked up and less money spent on fertilizer. This allows great savings to be made, but again needs either variable rate maps or a very good knowledge of the field and soil types. Send mid-season soil (top and sub soil), for in-season Nitrogen testing to allow you to make an informed decision as to whether an N top-dressing is required. This saves you on fertiliser costs, will reduce the chance of lodging from excess N, and the chance of lower yields from under application of N.

3. Drilling date. The earlier a crop is sown, in generally the more chance there is of heavy rain hitting it in the later stages of grain fill when it is at its most vulnerable. On the other hand, a crop sown in November or May will finish in a drier period when storms are less likely to know the crop over. This of course has to balanced against the risk of the crop running out of moisture.

4. Root diseases. The wider the rotation, the stronger the root system and better anchorage. This is an interesting dynamic because barley in rotation also tends to yield far better than continuous cereals, so the crop will however be heavier and still at risk!

5. Fungicides. *Prothioconazole* does a very good job of strengthening the straw in addition to its disease control.

6. Balanced nutrition. Potassium is a key nutrient which when lacking can lead to weaker stems, but in most soils in Kenya is adequately supplied. Balanced nutrition is key so address Nitrogen, Sulphur, Magnesium, Copper and possibly Boron. Ultimately this has the double benefit of greater yields and disease resistance too. Know your soils, test your soils and get a proper fertiliser program from CropNuts that takes into account the nutrient levels in your soil and the yield-based nutrient requirements for the crop.

David Jones is an agronomist

Insect Management in Cereals

Once fields are properly scouted, data can be used to determine insect control options. Course of action should be started only when you are fully armed with up-to-date, accurate information
writes Thomas Kipkorir

Proper crop rotation with alternate crops is an essential practice in any crop production to reduce buildup of insects, weeds and diseases. Insect attacks do not always result in economic injury, so certain insect management practices can be used to ensure cost-effective control decisions.

Scouting for insects.

Depending on location and when the crop is planted, insect problems vary from non-existent to severe. Identifying the pest and understanding its potential for damage is necessary when selecting appropriate control methods. Each pest does not respond the same way to a given method. Monitor fields at least twice per week. Walk a "V" or "W" pattern through the field and select plants from 12 random locations along the pattern. When plants are still small (up to 10 leaves), examine 6 adjacent plants per location for insects and disease. As plants get larger sample 3 leaves per plant on 6 adjacent plants per location (total of 216 leaves).

Insects cause injury to the leaves, stems, roots, and fruit. The developmental stage of the plant at the time of attack often governs which plant part different insect pests may injure. However, some insects feed specifically on one plant structure; others may feed on several structures. The first step in control is to identify the insect.

Certain cultural practices may have a dramatic effect on the potential for economic injury by certain insects. Planting during optimal growing conditions ensures rapid seedling emergence and subsequent growth. This reduces the amount of time that plants are susceptible to injury from seedling insect pests.

Most insect problems can be treated as needed if detected early, but no one insecticide will adequately control all the insects that may attack a crop. Scouting for insects is the most efficient way to determine what problems may exist and what action should be taken.

Preventive treatments may be necessary for certain insect pests. Preventive treatments are used against insects that are certain to cause economic injury if they are present. Field history, harvest dates and insect pressure in nearby production areas influence preventive measures decisions.

In addition to monitoring for pest insects, some beneficial species exist which should be considered. Several species of predatory and parasitic insects are present in crops. These natural controls are considered especially during early season. Big – eyed bugs, minute pirate bugs, fire ants and Cotesia wasps are four important beneficial insects. The presence of these natural controls may delay the need to treat for bollworms. The use of beneficial insects should be maximized in attempts to reduce production costs.

Thomas Kipkorir

Decision to apply an insecticide should be based on scouting and the use of threshold. Scheduled or automatic applications of insecticides should be avoided because unnecessary application can be more costly than just the cost of the insecticide. Application of insecticides on an as-needed basis will allow beneficial insects to be preserved which reduces the likelihood of secondary pest out breaks.

Resistance Management

In a population of resistant insects, insecticide resistance levels to a particular class of insecticide increase each time that class of insecticide is used. Once a material is used, its level of effectiveness will likely be reduced against subsequent generations within the season.

To Page 18

Red Flour Beetle

Aphids

Dried bean weevil

From Page 17

Therefore, alternating the use of insecticide classes on different generations of insects during the season is a highly recommended resistance management tactic. Since most insect pests are highly mobile, such a strategy will be most effective if adopted by all farmers in a large geographic area.

Pesticide precautions

- Observe all directions, restrictions and precautions on pesticide labels. It is dangerous, wasteful and illegal to do otherwise.
- Store all pesticides in original containers with labels intact and behind locked doors. Keep pesticides out of reach of children.
- Use pesticides at correct label dosage and intervals to avoid illegal residues or injury to plants and animals.
- Apply pesticides carefully to avoid drift or contamination of non – target areas.
- Surplus pesticides and containers should be disposed of in accordance with label instructions so contamination of water and other hazards will not result.
- Follow directions on the pesticide label regarding restrictions as required by Laws and Regulations.
- Always dispose pesticide containers by burning and burying and not throwing away in water bodies or garbage dumps.

Scouting for insect pest is important for two reasons. Yearly scouting helps you build an on-farm database that can be used to select appropriate insect management tactics for future crops. Scouting also helps you determine if and when to spray insecticides. Once fields are properly scouted, data can be used to determine insect control options. Course of action should be started only when you are fully armed with up to date, accurate information.

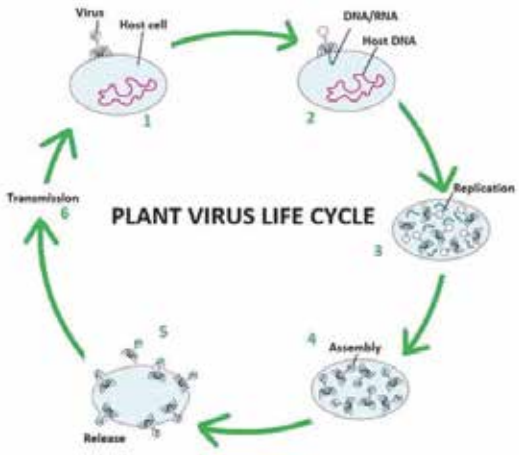
An Introduction to Plant Viruses

Plant viruses are viruses that affect plants. Like all other viruses, plant viruses are obligate intracellular parasites that do not have the molecular machinery to replicate without a host.

Plant viruses are pathogenic to higher plants. They can cause a dramatic decrease in yield, quality and shelf life and even plant death. Plant virus are made up of a strand of nucleic acid (DNA or RNA) surrounded by a protein sheath. Technically they are not living, as they are not cell based so cannot move or replicate by themselves. There is no cure for plant viruses, they must be managed with cultural practices and virus resistant plant stocks.

Plant viruses can cause major crop losses and greatly reduce quality and storage or products (vegetable/ornamentals and grains). Viruses can remain dormant and express when plants are unhealthy or stressed. They can join with other pathogens and plant viruses to form disease complexes that can decimate crops. They mutate very fast and new strains emerge all the time.

Life Cycle of Plant Viruses



1. *Attachment* – the virus attaches itself to the outside of a plant cell.
2. *Penetration* – the protein pushes the nucleic acid strand into the plant cell
3. *Replication* – the viruses' nucleic acid uses the plant cell DNA to make many new nucleic acid strands and protein sheathes
4. *Assembly* – the nucleic acid and protein assembly into millions of new virus copies
5. *Release* – the viruses leave the cell – at this stage the cell is normally dead and bursts releasing the viruses
6. *Transmission* – the viruses move using a vector to new cells to infect.

Symptoms of Viral Diseases in Plants

The symptoms of viral diseases in plants is important for virus identification and are often used to name the virus. The symptoms will change according to the

plant virus strain / mixed virus infections, the host plant species, the nutritional status of the plant, the age of the plant, the stage of the infection and physiological growing conditions. Plant virus symptoms can be confused with bacterial and fungal diseases, nematode infections, plant nutrient deficiencies, abiotic stresses and herbicide injuries.

It is generally very difficult to identify a virus from symptoms alone. Viruses are sub-microscopic and plant samples should be sent to the laboratory for confirmation. Viruses can be present but not expressed in healthy plants, weeds, and cuttings and seedlings. Symptoms can appear when the plants are stressed and in hotter weather. Multiple viruses can be present in one plant, and/or be present with bacterial or fungal infections that can form disease complexes that can be catastrophic with 100% plant loss.

Plant virus symptoms include, but are not limited to the following:-

- Mosaic or mottled leaf patterns
- leaf yellowing
- chlorosis
- vein clearing
- green vein banding
- yellow vein banding
- leaf rolling
- leaf curling
- leaf shoe-stringing
- leaf blistering
- witches' brooms
- bunchy tops
- leaf tip necrosis
- veinal necrosis
- ringspots
- plant stunting
- wilting, tumours/galls
- colour streaking in flowers, leaves or fruits
- plant death

Importance of Identifying Plant Viruses

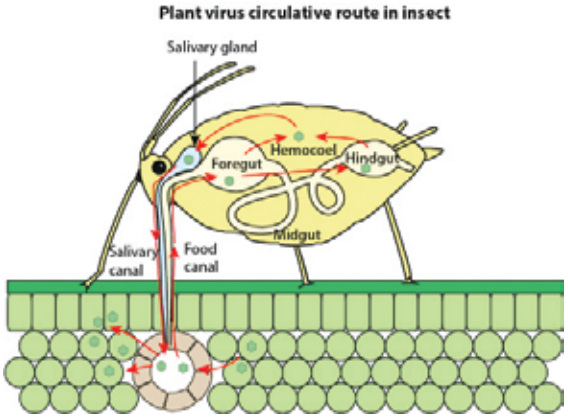
By identifying the viruses infecting your plants you can look closely at the life cycle / the method of transmission/vector/host plants and level of damage that they can cause. Then you can make an informed, fact driven, scientifically based strategy to control it.

Propagation is a common form of virus transmission – it is important to screen plants, cuttings, seeds, starter material for viruses to ensure that the material is clean and virus free at the onset of any project, especially projects in new areas.

Potato seed can be screened for viruses and bacteria before planting – this allows the farmer to make an informed decision to use farm saved seed or buy in new seed. This also applies to other seeds for e.g. wheat, soybean & tomato seed. Sometimes, if you are aware you have a virus in your crop a special seed treatment can clean the seed.

Transmission of Plant Viruses

Viruses are technically non-living and cannot move around by themselves. They require a transmission method and often a vector. By removing the vector or understand the transmission mechanism you can put hygiene protocols in place to control the spread of plant viruses.



Most plant viruses depend on insect vectors for their survival, transmission and spread. Image: ViralZone

Viruses can be transmitted in the plant sap via direct mechanical transmission. If your hands or tools get plant sap on and you then touch a clean plant, you can move the virus around. Some viruses do not last long outside a plant (semi-stable) while some viruses like Tobacco mosaic virus (TMV) and Tomato mosaic virus (ToMV) are very robust and stabile and remain infective for 2 years after drying.

Plant virus vectors are generally insects that carry move the virus around on their mouth parts or salivary glands. The viruses can be transmitted by insects persistently – the insect acquires the inoculum and can transmit the virus indefinitely until the insect dies. Insects can transmit the virus non-persistently – the virus moves just to one plant, or semi-persistently – where the inoculum can remain infective for several hours.

Plant viruses generally cannot survive on their own and tend to live and perpetuate in host plants. These are neighbouring plants, commercial crops, volunteer plants or weeds that breed the virus up and act as reservoirs for new inoculum. Very often the host plants will show no symptoms. It is important to identify the potential reservoirs and remove the plants to stop the virus cycle continuing from one planting to another.

Maize Lethal Necrotic Disease

This is caused by the maize chlorotic mottle virus (MCMV) combining with a potyvirus, in Kenya this is the sugarcane mosaic virus (SCMV), to create a virus disease complex in the plants that is potentially fatal. The SCMV was first identified in Kenya in the 1930's and is widespread, not causing much damage as our germplasm is quite resistant to it. MCMV was first noticed in Kenya in 2012 and caused up to 100% yield loss in the areas that were affected.

Transmission from place to place is via seed, in the seed coating, and inter-plant transfer is via several insect vectors. Testing seed plants, rogueing (removing and burning) symptomatic plants, special seed cleaning treatments and planting resistant varieties go a long way to reduce spread and damage.

CIMMYT Director General Gains Insights into Breeding Activities at Kiboko Research Facility

In a recent visit to KALRO facilities in Kiboko, Kenya, CIMMYT commits to advancing the deployment of climate-resilient maize varieties in eastern and southern Africa.

By Marion Aluoch

During a visit to CIMMYT facilities on the agricultural research station of the Kenya Agricultural and Livestock Research Organization (KALRO) at Kiboko, Bram Govaerts, CIMMYT director general, extolled the longstanding partnership with KALRO and suggested creating a platform to speed access of national researchers to improved breeding lines and populations.

Located 155 kilometers southeast of Nairobi in a dryland area better suited to raising cattle, goats, sheep, and camels than row crops, the Kiboko station comprises more than 15,000 hectares, with controlled irrigation systems, and has allowed efficient selection for tolerance to drought and insect pests in Africa-adapted maize, as well as the development of dryland crops such as pigeon pea, sorghum and groundnuts.

Dr. Bram Govaerts, Director General of CIMMYT

"Our recent work where we open up our maize and wheat research platform for dryland crops highlights CIMMYT efforts to diversify cropping options for farmers in challenging settings, enhancing their livelihoods and farming system resilience," Govaerts said.

Yoseph Beyene, CIMMYT maize breeding coordinator for Africa, described collaborative efforts to speed the breeding and deployment of climate-resilient varieties. "This work covers maize breeding and seed system networks, participatory engagement with farming communities through on-farm trials, interactions and sharing with global partners, and documenting the adoption of stress tolerant maize in sub-Saharan Africa," Beyene explained.

CIMMYT data show that drought-tolerant maize varieties derived from shared research of the Center, CGIAR and partners are being sown on more than 6 million hectares in 9 countries of eastern and southern Africa, benefitting an estimated 38 million people and producing additional grain worth as much as US$1.5 billion each year.

Drought Tolerant Maize

Govaerts, Das and Beyene listen to laboratory staff explain advances in climate-resilient maize.

Govaerts examines improved fall armyworm tolerant experimental varieties.

Beyene added that the expansion of on-farm testing to over 1,000 locations in eastern and southern Africa has enabled CIMMYT to assess preferences and genotype-by-environment interactions which, along with support from the seed systems team regarding small-scale farmers' acceptance of drought-tolerant maize hybrids, have underpinned the development of successful hybrids.

A prominent stop on Govaerts's tour was the maize double haploid (DH) facility established in Kiboko in 2013, with funding from the Bill & Melinda Gates Foundation. Long used by private seed companies, the double haploid approach generates inbred lines that are completely "homozygous," wherein genes on each pair of chromosomes are identical. It achieves this in a single year, compared to three to four years for conventional inbreeding, which can produce lines that may not be purely homozygous and are thus less useful for breeders.

"The facility offers double haploid line production services for organizations throughout Africa and is key to increasing genetic gains in maize breeding," said Aparna Das, technical program manager for CIMMYT's Global Maize Program.

Govaerts also visited the fall armyworm (FAW) artificial screening site and experiments in which CIMMYT scientists are evaluating five new FAW-tolerant experimental varieties for possible sharing with partners. In the fall armyworm screening facility, a team works to integrate and test ecofriendly crop management solutions against fall armyworm, critical research to safeguard agricultural production against this highly destructive insect pest.

"The excellent teamwork and facilities at Kiboko point up multiple opportunities for KALRO and CIMMYT to continue joint work that advances agricultural science to benefit farmers and consumers," Govaerts concluded.

Floods, Droughts & The Soil

Turning soils into sponges: Opportunities to reduce flood and drought risks

By Ruth

You may think that the common factor between drought and flood in many places in Kenya is water, especially lately. Other than the lack or abundance of rain, the major reason for droughts and floods is the soil's health status and its inability to absorb, store and release water.

Soil is the upper layer of the earth on which plants grows, and animals live on. It is made up of organic matter and inorganic matter – sand, silt and clay. 75% of the earth's surface is water. 25% of the earth's surface is soil. Of the 25% of the earth's crust that is soil – it can be broken down into the following uses.

Agriculture currently accounts for about 20% of the land use. Agriculture is essential for human existence. Without food we wouldn't be here. The human population continues to grow, with an increasing demand for food. This puts pressure on the current agricultural area and we see forests and environmental land being cleared to increase this production. In addition to this, bad agricultural practices on marginal land, continue to turn agricultural land into arid land. Further putting pressure on our forests and ecosystems.

Turning Soil into Sponges

To start with we need to protect and increase our forest areas. Forests in our mountain ranges and hilltops are essential for regulating two climate patterns. Water and wind. The trees act as wind breaks and slow the wind down. The vegetation, roots and soft thick soils absorb heavy rainfall like a sponge and slowly release it into our streams and rivers, supplying water in the dry season and reducing floods in the wet seasons. Hence, the common term "water towers". In addition to this, trees can capture water out of the air by condensation, creating a natural drip zone, even without rain.

Forest soils are very fragile and rely on their full ecosystem for their fertility and water holding capacity. Clearing forests irreparably damages the soil and the efficiency of our natural water towers.

A healthy soil is a productive, stable soil. So, protecting and enhancing the soil health in agricultural land brings financial returns to farmers as well as helping in the mitigation of natural disasters and climate change. This is true for cropped and grazed soils. In the process of absorbing and releasing water, healthy soils naturally reduce the likelihood of droughts and floods.

Flood & Drought Resistant Soil

What soil properties are important factors in determining how much water is held? Well, soil texture is important – the amount of clay, loam and sand. But we cannot change this easily.

Soil depth is most important. A shallow soil holds much less water and quickly produces run off (floods and erosion). We need to protect and build up our soils, to reduce erosion of valuable topsoil and increase the soil depth. Soils that have been eroded down to bed rock – hold no water at all. Soils can be artificially shallow due to a plough pan or compacted zone created by tillage for crop production. The disk plough is a big agronomic disaster. The disc plough turns the soil over and buries the biologically active, organic matter and nutrient rich topsoil away from the plant roots, it generally creates a plough pan at 15-20 cm deep.

In a soil that is 1m deep, with a water holding capacity of 100 mm/m, the land can absorb 4 inches of rain or a million liters of water/ha. A soil with a plough pan at 20 cm can only absorb a fifth of this, creating 800,000 liters/ha of run off. A crusted degraded soil holds no water at all, creating a million liters of run off (a flood!).

The land's ability to hold and absorb water depends on several properties that are influenced by human activity. It goes without saying that rooves and hard road surfaces create nearly 100% run off that must be captured / diverted / controlled by good planning.

In soils, the moisture holding capacity and soil 'strength' depends on the following features that we can control: soil porosity, organic matter content, chemical makeup, roots, and crumb structure.

Soil Porosity

Soil porosity is defined as the number of pores, voids, open spaces between soil particles. The pores hold air and water. Pores spaces may be formed by the movement of roots, earthworms and insects through the soil. The more porous the soil, the better the water can infiltrate. The greater the volume of pores, the higher the storage capacity of the water. Healthy soils with good porosity, absorb and store water deep into the soil, reducing flooding. The same pores allow the roots to penetrate deep into the soil to mine the nutrients and stored water required for growth – so that plants can grow and transpire in the "drought". Mechanical, human and livestock movement over the soil can substantially compact the soil and reduce soil porosity.

Organic Matter

Organic matter content improves the strength of the soil by holding the soil particles together creating a strong porous crumb structure that resists erosion, improves water infiltration and increases the soil's inherent ability to hold water. Organic matter acts like a giant sponge and can hold 400X more water than sand. A 1% increase in organic matter can increase the soil moisture holding capacity by 4%.

Modern farming practices of tillage and inorganic fertilizers quickly burn out the organic matter and reduce the soils' ability hold water and fertilizers and to grow high yielding crops. A healthy soil should have at least 3-5% organic matter. This, on its own, can absorb about 3-500,000 liters/ha water & sequester several tons of carbon/ha– alleviating climate change.

Soil Chemical Make Up

The chemical makeup of the soil is very important for its crumb structure, strength and porosity. Inorganic soil particles are negatively charged need positively charged particles to hold them together – these include the soil cations and organic matter. Organic matter contains large particles with many positive charges and very effectively binds the inorganic soil particles together.

Calcium (large) and magnesium (small) have two positive charges and can hold two soil particles together, potassium and sodium have only one positive charge and are very small, they can disperse the soil – crusting it and a substantially reducing water infiltration. The amount and the ratio of the positively charged cations determines the soil structure, strength, and water infiltration: – reducing wind and water erosion, loss of topsoil and floods.

Adding just NPK to the soil and not considering the nutrient removal of all the soil nutrients, mines the soil of valuable cations, can cause acidification, loss of structure and big reductions in yields, root structure and plant cover.

Roots & Crumb Structure

Overgrazing substantially reduces the soils ability to absorb water, by removing the plant cover, root structure and organic matter, by carrying the soil nutrients off the land, and by plugging the soil pores and crusting the surface through the action of the hooves walking through the soil. Overgrazed soil quickly deteriorates, does not absorb water that is required for the grassland to regrow and produces a great deal of run off. In Kenya, and other hot countries, we see a big salt accumulation in overgrazed soil, due to excess evaporation, to the point that soils quickly become crusted and arid, and unsuitable for anything.

Healthy Soil & Drought And Flood Management

So, what can we, as farmers, do to reduce droughts and floods? Good agricultural practices to build deep healthy soils! Test the soils, balance the cations, increase the soil organic matter, use no till or reduced till farming methods, plant trees, maintain forests and grasslands, rotate deep rooted crops, manage crop residues so that the soil is never bare, don't overgraze and most importantly manage for healthy soils that will give you high yielding, healthy crops and grass lands.

Digitizing the food industry to increase resilience

By Arvind Pal Singh

Food supply chains continue to face significant disruption, which has been predicted to only worsen or at least, stay the same, as the year goes on. Meanwhile, the industry is also subject to safety concerns, and the need for increased resilience to market uncertainty and disruption has never been more crucial. To be future-fit, the food industry must embrace a new value chain built around new business models, practices and technologies that can enhance operational capabilities.

1. Reengineering the food supply chain for resilience

Building resilience into the global food supply chain begins with accepting that things cannot go back to the way they used to be. In a world facing a growing population that's expected to reach 8.5 billion by 2030, as well as a climate crisis, food supply chains must be strong, nimble, and smart.

The past decade has seen a growing dependence on imported grains, fruits and vegetables in many countries, however the food industry is under pressure to reduce post-harvest food losses. It's also working to cut its dependence on vapour compression-based cold storage, which is a major contributor of greenhouse gases. This means production needs to move closer to the consumer and the industry needs to invest in new-age cold-storage solutions that reduce energy consumption. In the long run, this translates into creating a more diversified food supply chain that's better able to handle disruption.

Food retailers must optimize their last-mile delivery mechanisms. To provide on-time delivery while optimizing delivery costs, businesses need greater automation in their warehouses and delivery partners that can provide real-time visibility of shipment status for online buyers. Automation of brick-and-mortar stores can also provide a frictionless and safer buying experience for in-store customers.

2. Build transparency and trust

Satisfying the food safety concerns of today's increasingly health-conscious and well-informed consumer requires constant monitoring of products from farm to table, as well as the ability to use gathered data to improve visibility across manufacturing and distribution. Internet of Things (IoT) technologies deployed throughout the value chain can collect and present data to improve visibility and create data-driven processes and decisions for businesses. This also improves the ability of companies to respond to unforeseen disruptions.

Similarly, technology like blockchain has emerged as a reliable way to track not just food products but the ingredients they consist of. For down-chain players such as grocery stores and restaurants, this data can help identify and reduce contamination and, in the case of product recalls, identify impacted shipments. This level of detail and monitoring will become increasingly relevant for building customer loyalty and trust.

3. Overcoming retail barriers with digital offerings

For retailers and grocers, Covid-19 demonstrated the need for a digital-first approach when it comes to customer engagement. This requires a deep understanding of customers, which can only come from enhanced data collection and analytics capabilities, which is becoming easier thanks to the rise of online shopping.

Many consumers prefer to grocery shop from home, so retailers must find ways to blend elements of in-store shopping with their digital offerings. In-store associates, for example, can be replaced by virtual store associates or artificial intelligence-enabled chatbots. Making these changes means rethinking the entire customer journey and identifying opportunities made via promotional online offers. Being data-driven also enables retailers to build trust with customers for example, by providing information about food's origins and ingredients.

4. Advancing automation for safety and efficiency

For the food industry, automation holds great promise; the scope for automating manual processes in the food value chain extends all the way from the farm to the dinner table. For example, robotic farming, combined with crop-status analysis, can save time while quantifying yield potential and environmental impact of crops. In warehouses, automated storage and retrieval systems can manage a variety of food products under different storage conditions. Meanwhile, at packaging facilities, restaurants and retail stores, robotics can automate repetitive processes with remote oversight and minimum human intervention, reducing human errors and food contamination.

5. Building digital-era skills and culture

While large-scale automation will replace some jobs, it will supplant them with new ones. Already, early AI adopters in the food industry have experienced an uptick in the demand for high-skill jobs. However, this puts the food industry in direct competition with other sectors for digital talent. Those that focus on upskilling existing talent and making the most of the expertise from reliable technology partners therefore stand in best stead to succeed.

A digital-first world

The uncertain and quickly changing world we live in continues to exacerbate the challenges faced by the global food industry, but technology offers huge opportunity to solve them while developing a better understanding of their customers through data-driven insights.

Food industry leaders need to take the opportunity to use technologies to drive a ground-up transformation of their supply chain while understanding customers better through data-driven insights. This will not only benefit the environment, but also help boost their own revenues, setting them up for success in the future.

Arvind Pal Singh is the Vice President, Products & Resources Consulting, GGM at Cognizant.

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Post-Harvest Wheat Management in the Face of Climate Change

Post-harvest wheat management includes activities such as harvesting, drying, storage, and transportation, all of which can be influenced by climate change in various ways.

Climate change is one of the most pressing challenges of our time, and its impacts are being felt across the globe. As a climate-sensitive sector, agriculture is particularly vulnerable to the changing climate. Wheat, one of the world's most important staple crops, faces significant challenges in the post-harvest phase as a result of climate change.

The Impact of Climate Change on Wheat Production

Wheat is a vital source of food for billions of people worldwide. It is grown in a wide range of climatic conditions, making it susceptible to the effects of climate change.

The impacts of climate change on wheat production are multifaceted:

1. Changing Temperature Patterns

Rising global temperatures can affect wheat yields in several ways. High temperatures during the grain-filling period can reduce the number of grains per spike, resulting in lower yields. Additionally, extreme heat events can lead to heat stress, affecting wheat quality and reducing grain protein content.

2. Altered Precipitation Patterns

Changes in precipitation patterns, including increased variability and more frequent droughts, can negatively impact wheat production. Drought stress during critical growth stages can lead to yield losses and poor grain quality.

3. Increased Pests and Diseases

Climate change can create more favorable conditions for pests and diseases that affect wheat. Warmer temperatures can lead to the proliferation of pests like aphids and the expansion of disease ranges, such as Fusarium head blight and wheat rusts.

4. Water Scarcity

In many regions, water scarcity is exacerbated by climate change, posing a significant challenge to wheat production. Reduced water availability can lead to decreased irrigation capacity, affecting crop health and yields.

5. Extreme Weather Events

Climate change increases the frequency and intensity of extreme weather events like storms and heavy rainfall. These events can lead to lodging (when wheat plants bend or break due to strong winds or heavy rain), which can result in yield losses.

Dry wheat fields

Post-Harvest Challenges

While the focus of climate change discussions often revolves around the impact on crop growth and development, it's equally important to consider the challenges that arise in the post-harvest phase of wheat production.

1. Harvest Timing

Climate change can affect the optimal timing for wheat harvest. Rising temperatures may accelerate wheat maturation, leading to shorter growth cycles. Farmers must adapt their harvesting schedules to ensure that wheat is harvested at the right stage of maturity to maintain quality.

2. Drying

Proper drying is crucial to reduce wheat moisture content and prevent mold growth during storage. Climate change can

Wheat field

disrupt traditional drying methods due to increased humidity or precipitation, making it necessary to invest in advanced drying technology or facilities.

3. Storage

Warmer temperatures can increase the risk of insect infestations and fungal growth in stored wheat. Improved ventilation and pest control measures are necessary to maintain grain quality. Climate-resilient storage solutions, such as hermetic storage bags, can also help protect the crop.

4. Transportation

Extreme weather events, including heavy rains and flooding, can disrupt transportation routes and infrastructure. Developing resilient transportation systems and supply chains is essential to prevent delays and losses during transit.

Adaptation Strategies for Post-Harvest Wheat Management

To address the challenges posed by climate change in post-harvest wheat management, a combination of adaptation and mitigation strategies is required:

1. Improved Weather Forecasting

Enhanced weather forecasting and early warning systems can help farmers plan their harvest and post-harvest activities more effectively. Timely information on weather patterns, including rainfall, temperature, and humidity, can inform decisions about drying and storage.

2. Infrastructure Investments

Investing in infrastructure upgrades is essential to adapt to changing climate conditions. This includes modernizing grain drying facilities, improving storage structures, and fortifying transportation networks to withstand extreme weather events.

3. Climate-Resilient Storage Solutions

Farmers can adopt climate-resilient storage solutions like hermetic storage bags, which create airtight conditions to prevent insect infestations and mold growth. These bags are particularly effective in regions prone to high humidity.

4. Sustainable Practices

Implementing sustainable agricultural practices can help build resilience to climate change. Conservation agriculture, which promotes minimal soil disturbance and crop residue retention, can improve soil health and reduce the impacts of extreme weather events.

5. Crop Diversification

Diversifying crop production by integrating wheat with other climate-resilient crops can help reduce the overall risk to farmers. Crop rotation can also break the cycle of pests and diseases that may affect wheat.

6. Research and Innovation

Continued research and innovation in wheat breeding are essential to develop climate-resilient wheat varieties that can withstand the changing conditions. These varieties should have improved heat and drought tolerance, as well as resistance to pests and diseases.

7. Knowledge Sharing

Education and knowledge sharing among farmers and agricultural extension services are crucial for the successful implementation of adaptation strategies. Farmers need access to information and training on climate-smart practices.

Mitigation Efforts

While adaptation is crucial, mitigation efforts to address the root causes of climate change should not be overlooked. Reducing greenhouse gas emissions from agriculture, such as methane from rice paddies and nitrous oxide from fertilizer use, can contribute to a more sustainable future for wheat production.

Implementing precision agriculture practices, optimizing fertilizer use, and reducing post-harvest food waste can all help lower the carbon footprint of wheat production.

All in all, Climate change poses significant challenges to wheat production, from the field to post-harvest management. To address these challenges, farmers, researchers, and policymakers must work together to implement adaptation and mitigation strategies.

Additionally, efforts to reduce greenhouse gas emissions from agriculture can contribute to a more sustainable and resilient food system in the face of climate change. By taking action now, we can protect global food security and support the livelihoods of millions of farmers who depend on wheat production.

Nairobi International Trade Fair 2023: A Promising Vision for Sustainable Agriculture and Economic Growth

By Mary Mwende Mbithi

The 2023 Nairobi International Trade Fair was a resounding success, drawing thousands of visitors from various corners of the globe to the Jamhuri ASK Grounds in Nairobi from September 25th to October 1st. This year's theme, "Promoting Climate Smart Agriculture and Trade Initiatives for Sustainable Economic Growth," set the stage for a week of insights and innovation in the agricultural and trade sectors.

The event aimed to be a melting pot, bringing together industry players from various sectors, ranging from manufacturers to small and medium-sized enterprises (MSMEs), by providing platforms for innovative solutions, modern technologies, financial and advertising services, as well as live demonstrations. It was a testament to the significance of agriculture in Kenya's economic and industrial development, emphasizing income generation and the provision of raw materials for manufacturing.

President Ruto, during the official opening of the trade fair, highlighted the government's commitment to reforms aimed at increasing food production and reducing the cost of living. He stressed that agriculture remains the backbone of Kenya's economic activity, and transforming agricultural productivity is a pivotal strategy to revitalize the nation's economy.

The fair focused on sustainable agriculture and cutting-edge technologies, with the President noting that elevating the Nairobi National Agricultural Show to an international trade fair was a strategic move, considering the central role agriculture plays in Kenya's economic activity.

President Ruto stated that agriculture and trade are interconnected and directly influence the performance of other economic sectors. He stressed the need to move beyond subsistence agriculture and to emphasize competitiveness, productivity, efficiency, value addition, manufacturing, and trade.

The President outlined several government measures to transform the agricultural sector, including providing adequate and affordable working capital to farmers to boost productivity. The government also aimed to manage agricultural-related risks comprehensively to protect farmers from the uncertainties of farming.

He further pledged support for two million food-deficient farmers, assisting them in becoming surplus producers by offering affordable finance for inputs and agricultural extension services. Additionally, the government was working to revive underperforming or collapsed export crops like rice, coffee, cashew nuts, pyrethrum, avocado, and macadamia nuts.

In addressing the challenges faced by sugar and coffee farmers, President Ruto announced the approval of the write-off of Ksh 117 billion owed by state-owned sugar companies to pave the way for leasing the mills to private sector entities. This intervention aimed to inject competitiveness into the sector and return the mills to the communities on a cooperative model after the leases expired.

Regulatory reforms were also in progress to empower farmers and stakeholders in the sugar industry, ensuring their direct involvement in the sector's affairs.

Regarding the coffee sector, President Ruto acknowledged market challenges but reassured that the government was committed to resolving the issues and preventing a repeat of past hardships faced by coffee farmers.

The President revealed plans to lease idle land held by public institutions to private investors under the Land Commercialization Initiative, which would help address the decreasing availability of land for farming.

Nairobi Governor Johnson Sakaja emphasized that the development of the agricultural sector remained crucial for addressing the country's challenges. He promised to create a conducive environment for farmers and to establish markets for their produce. Governor Sakaja also noted that the county government was keen on supporting urban agriculture, reiterating that, in order to grow economically and be food secure, the country had to embrace technology and innovation in the agricultural sector to increase yields.

Key officials, including Cabinet Secretaries Aden Duale (Defence) and Simon Chelugui (Cooperatives and Micro and Small Enterprise), Attorney General Justin Muturi, and Deputy Chief Justice Philomena Mwilu, were present at the event, reflecting the significance and widespread support for the trade fair's mission to promote sustainable agriculture and economic growth.

The Awarding Ceremony

The official opening ceremony of the event was a vibrant affair, highlighted by a colorful awarding ceremony presided over by President William Ruto. The honorees covered a wide spectrum, spanning ten distinct categories that recognized excellence in agriculture, from large commercial farmers to special categories aimed at acknowledging the contributions of women, youth, and physically challenged farmers.

The ASK Awards, an annual event, is traditionally overseen by the president, who also serves as the patron of the affair. For well over a century, this event has continuously grown, drawing participants and exhibitors from the local, regional, and even international levels. Over the years, the fair has evolved to encompass not only agriculture but also other key sectors of the economy, including information and communication technology (ICT) among others.

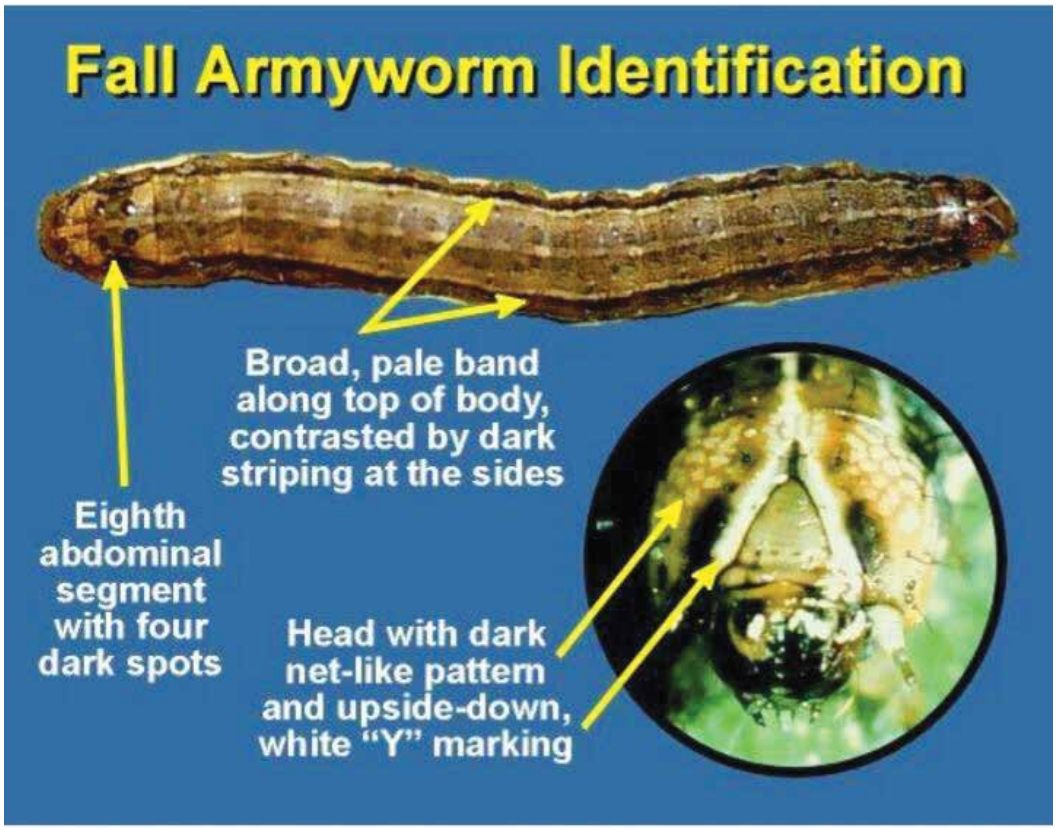
During the award ceremony, Elgon Kenya, a prominent supplier of agricultural inputs in East Africa, was among the recipients of accolades for their innovative approaches to addressing the challenges confronting the agricultural sector in the region.

According to Dr. Bimal Kantaria, the Managing Director of Elgon Kenya, the company has been actively supporting the presidential awards for the past eight years, playing a crucial role as a key sponsor, while the Ministry of Agriculture serves as the panel of judges. Together, this partnership has successfully revitalized the 4K Clubs in schools, with over a thousand schools across the country participating.

A particularly outstanding achievement was celebrated as St. Luke's School for the Deaf 4K Club emerged as the overall winner among more than 100 entries from all corners of the country. Their success was a testament to the impact of the collaborative efforts of Elgon Kenya, the Ministry of Agriculture, and the dedication of these schools to promote excellence in agriculture.

In conclusion, the 2023 Nairobi International Trade Fair offered a glimpse into Kenya's ambitious plans for a sustainable and prosperous future. It highlighted the nation's dedication to harnessing cutting-edge technologies, sustainable agriculture, and trade initiatives to drive economic growth while safeguarding the environment. As industry players and innovators converged at this event, it became clear that Kenya's path to economic prosperity and food security lies in the synergy between agriculture and trade, supported by government initiatives and private-sector partnerships.

Managing the Fall Army Worm (FAW) Outbreak



A combination of native African armyworms and Fall armyworms from the Americas are ravaging staple crops across Africa. If uncontrolled, they have the potential to cause major food shortages. The Conversation Africa's energy and environment editor Ozayr Patel asked Kenneth Wilson to explain the threat and what can be done about it.

What are armyworms, where do they come from and how do they travel?

Armyworms are the caterpillar stage of moths belonging mainly to the genus *Spodoptera.* They are called armyworms because when they have ravaged a crop they march along the ground like a vast army of worms in search of more food.

Because armyworms feed on many of the staple food crops they have the potential to create food shortages in the region. The recent outbreaks appear to be a combination of the native African armyworm (*Spodoptera exempta)* and a new invasive species called the Fall armyworm (*Spodoptera frugiperda)*. This new species is endemic to tropical and subtropical regions where it causes considerable damage to maize and other crops.

What makes them so devastating?

Both African and Fall armyworms do most damage to the staple cereal crops such as maize, wheat, sorghum, millet and rice. They also eat pasture grasses which has an impact on livestock production.

The African armyworm – they can be 3cm long – can reach densities as intense as 1000 caterpillars per square metre, quickly razing crops to the ground. On maize, the number of caterpillars per plant is, of course, much lower but it can cause just as much of an impact. The insects strip the leaves of even mature maize plants bare.

Unlike their African cousins, the Fall armyworm also feeds on a range of non-cereal crops. Nearly 100 different host plant species have been recorded. These include cotton, soybeans, groundnut, peanut, potato, sweet potato, spinach, tomato, sweet peppers, cabbage and tobacco.

Damage to maize is likely to have the biggest impact on farmers in Kenya because it's the main staple food crop in the region. The impact of the Fall armyworm is likely to be devastating because it eats the leaves of the plant as well as its reproductive parts. This damages or destroys the maize cob itself.

What are the potential economic consequences if the problem is not arrested?

Chemical pesticides have been mobilised in most countries. In Brazil, where armyworms can breed all year round, controlling them costs an estimated US$600 million a year. The cost of control in Kenya hasn't been determined yet.

But it's likely to be substantial given that many litres of imported chemicals. This means that even if control proves to be effective it will have been costly. The economic consequences could be severe if the Fall armyworm persists and spreads.

What is the best way to stop them damaging crops?

Chemical pesticides can be effective against both armyworm species. But resistance to many chemicals is an issue for the Fall armyworm throughout its native range. It's not known whether there is pesticide resistance in the Fall armyworms blighting East Africa.

The variable efficacy may be due to genetic resistance, or it might be as a result of the way in which the spray is applied. The Fall armyworms are often inaccessible to insecticides because of their tendency to hide in the whorls and reproductive parts of the host plant.

Which is the Main Species in Kenya?

The Fall Army Worm *Spodoptera frugiperda* invaded Kenya and established itself mainly in maize. There is a possibility that this pest may also invade sorghum, cotton, potatoes, some vegetables, onions sugarcane and other crops.

Management

Scouting, detection and pest identification: If pheromone traps are available, they can be placed according to the manufacturers' specifications to monitor moth flights and early moth arrivals. See pictures of moths for easy identification. Moths are grey or brown with irregular markings. Moths can be seen at night in crop fields.

Early detection is crucial; monitor by scouting crops every 2 days starting from the current wind direction, checking borders and centres of crop fields. Note all egg parcels, new hatchlings or young larvae penetrating the whorls. Egg parcels are covered by a woolly cover. The larvae are quite easy to identify: looking at the larva from its head gives the appearance of a dragon fly face with the markings on the head. Four dark spots in a square are also clearly visible on the 8thsegment. Their colour varies from green to dark green, pinkish, brown or dark brown with paler green longitudinal stripes.

Do not confuse this species with the african army worm or the false army worm. Check the head and 8th segment for the diagnostic characteristics!

Control

Spray insecticides as soon as the pest is noticed or if 5 – 10% of plants show infestation, e.g. 5 or 10 plants per 100

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Maize - Man Host of FAW in Kenya

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Damage to maize is likely to have the biggest impact on farmers in Kenya because it's the main staple food crop in the region. The impact of the Fall armyworm is likely to be devastating because it eats the leaves of the plant as well as its reproductive parts. This damages or destroys the maize cob itself.

Fall Army Worm Invasion

plants inspected. Use those active ingredients that have already been approved for the fall army worm.

Insecticides must be applied during the early development stages of larvae. Adult larvae may prove to be very difficult, if not impossible to control.

The best control is obtained when larvae feed on exposed leaf surfaces where insecticides can reach them outside cobs, ears and tassels.

As soon as larvae penetrate too deep into the whorl or feed inside the cob nothing will effectively control them. Small larvae are easier to control than that fully-grown larva that can reach up to 40 mm in length.

Farmers are urged to refrain from using any concoctions or unregistered mixtures and to adhere to the label specifications and dosage rates of the registered products.

Resistance management

Rotate pesticides groups with different modes of action (MoA) as indicated on the front panel of each pesticide label; simply rotating between active ingredients of the same MoA is not conducive to resistance management. Avoid treating consecutive generations of the fall army worm with pesticides with the same MoA.

Other Alternative Methods

Research is needed to work out which chemical is the best to control the strain of Fall armyworm. But there are alternative approaches.

In parts of their native range in the Americas, genetically-modified Bt maize is grown to combat the Fall armyworm. This may also be an option for Kenya and some other countries where GM crops are already grown. But many parts of Africa do not allow or welcome GM varieties. And Fall armyworm has also evolved resistance to some Bt toxins, with some evidence for cross resistance.

There are non-chemical, biological pesticides that could also be effective. These are pesticides derived from natural diseases of insects, such as viruses, fungi and bacteria. We have seen development of a highly effective biopesticide against African armyworm. But this still needs to go through the commercialisation and registration process, which is both costly and time consuming.

Biopesticides tend to be effective against a much narrower range of species than chemicals, which is good for the environment. But it means that they can only be used for a limited number of pests, often making them more expensive than chemicals.

There are also some other indigenous approaches that could be effective. This includes the use of local plant extracts like *Tephrosia vogelli* and neem, to produce botanical pesticides, and the addition of sand to maize whorls where armyworms are feeding.

Only time will tell what the full impact of this armyworm invasion will have.

Factors that Influence Herbicide Selection: Choosing the Right Tool for Weed Control

Weeds are a significant challenge in agriculture, landscaping, and natural resource management. They compete with crops for nutrients, water, and sunlight, reducing yields and overall productivity. To combat these unwanted plants, herbicides are a common and effective tool. However, selecting the right herbicide for a particular situation is crucial for successful weed control. Various factors come into play when choosing the most suitable herbicide, and understanding these factors is essential for effective and responsible herbicide use.

1. Weed Species and Life Stage

Different herbicides are formulated to target specific weed species. Some herbicides are broad-spectrum, effective against a wide range of weeds, while others are selective, targeting only specific types of weeds. Understanding the weed species in your area and their life stage (e.g., germinating seeds, established plants, or mature plants) is fundamental to choosing the right herbicide. For example, pre-emergence herbicides are applied before weeds sprout, while post-emergence herbicides are used on established weeds.

2. Application Timing

Timing is crucial when it comes to herbicide selection. Herbicides are most effective when applied during the appropriate growth stage of the weed. For example, post-emergence herbicides should be applied when weeds are actively growing and at their most vulnerable. Applying herbicides at the wrong time can reduce their efficacy and lead to herbicide resistance in weed populations.

3. Environmental Conditions

Environmental conditions can significantly impact herbicide effectiveness and safety. Factors such as temperature, humidity, wind speed, and rainfall can influence how herbicides work. Some herbicides work better in certain conditions, while others can be affected by adverse weather. It's essential to consider the local climate and weather patterns when selecting an herbicide to ensure it performs optimally and doesn't pose a risk to non-target plants or the environment.

4.Application Method

The method of application also plays a vital role in herbicide selection. Herbicides can be applied as sprays, granules, baits, or even injected into the soil. The choice of application method depends on the specific circumstances, such as the size of the area to be treated, the equipment available, and the targeted weed species. Proper equipment and application techniques are critical to ensure even and effective coverage.

5. Residual Activity and Persistence

Some herbicides have a short residual activity, while others can remain active in the soil for an extended period. Residual herbicides can provide long-term weed control, but they must be carefully selected to avoid damage to desirable plants or contamination of groundwater. Understanding the persistence of a herbicide is essential for planning crop rotations and managing potential environmental impacts.

6. Resistance Management

Herbicide resistance is a growing concern in agriculture and other sectors. Overreliance on a single herbicide or herbicide group can lead to resistant weed populations. Therefore, herbicide selection should be part of an integrated weed management strategy that includes rotating herbicides with different modes of action and incorporating non-chemical weed control methods.

7. Cost and Availability

Cost and availability are practical considerations when selecting an herbicide. Some herbicides may be more expensive than others, and their availability may vary by region. It's important to weigh the cost of herbicide products against their efficacy and compatibility with your specific weed control needs.

8. Regulatory and Safety Considerations

Herbicides are subject to regulations that vary by country and region. It is essential to be aware of legal restrictions, label instructions, and safety guidelines when choosing and using herbicides. Understanding the potential health and environmental risks associated with a particular herbicide is vital to protect both human health and the ecosystem.

In conclusion, selecting the right herbicide is a critical decision in weed management. It involves a comprehensive assessment of factors such as weed species, growth stage, environmental conditions, application method, residual activity, resistance management, cost, and safety considerations. By carefully considering these factors and integrating herbicide use into a broader weed management strategy, you can effectively control weeds while minimizing the impact on the environment and ensuring the long-term success of your weed control efforts. Responsible herbicide selection and application are essential for sustainable agriculture, landscaping, and land stewardship.

Protecting Bees from Pesticides

By David Jones & Anne-Marie Steyn

Yields in high value cash & export crops such as coffee, potatoes, avocados, pawpaws, watermelons, oranges, cucumber, passion fruit, etc, hugely depend on the pollination activities carried out by bees, butterflies, birds & other pollinators. Pollinators are essential to the production of many of the micronutrient rich fruits, vegetables, nuts, seeds and oils we eat. In fact, close to 75 percent of the world's crops producing fruits and seeds for human consumption depend, at least in part, on pollinators for sustained production, yield and quality.

The diversity of food available is largely owed to bees and other pollinators. But alarmingly, in a number of regions, pollination services are showing declining trends.

Pesticides & Bee Decline

Rampant misuse and overuse of chemical pesticides pose a great threat to bee pollinators and, to an extension, pose a risk to food security.

With the neonicotinoid pesticide ban already force in the EU by the end of this year, and the concerns this has raised among the farming community of what the other options are; some might ask how the use of pesticides is affecting indigenous pollinators here in Kenya.

Subsistence maize farmers, the majority, use very little fertiliser, let alone insecticides, except for situations such as the FAW outbreak, and potatoes, the second largest crop, usually require only fungicides.

However, in higher value cash crops and export crops such as coffee, beans, tomatoes and various fruit crops, insecticide use can be high. Recent press coverage has shown residue levels on local produce such as tomatoes to be above international health authority levels. Indeed, the majority of small holder farmers, though aware of the various risks of using pesticides, do not follow label instructions, and apply pesticides without due care or concern for PPE, application timings, pre harvest intervals, or pollinator activity. There is general consensus that the amount of insecticides being used in East Africa is increasing, and with this, the impact of those chemicals on local fauna.

There are over 40 neonicotinoid products registered in Kenya for use on crops ranging from coffee to tobacco, wheat and roses. African honey bees have been shown to be more sensitive to neonicotinoids than European honeybees.

Some of the pesticides approved for use in Kenya by the Pest Control Product Board (PCPB) are not approved in Europe because of their impact on human or environmental health. Pesticide labels show toxicity for humans but rarely LD50 for insects or pollinators – and with the low awareness about pollinators, and poor pesticide handling, it is unlikely that even label changes would cause pollinator related changes at the small scale farmer level.

Pollinators in Kenya include the various types of bees, flies, butterflies, birds and bats. Some of the important cash crops are dependent upon pollinators including the Cucurbitaceae, Eggplant, Passion fruit, mango and so on.

However, there have been widespread and fairly rapid impacts in chemical use among export growers, as top down directives directly impact the pocket of the grower. Revision of MRL levels trickles down to a reduction in the use of chemicals and improvements in the handling of pesticides on crops by farmers involved in those value chains.

Thus, the neonicotinoid ban in Europe is likely to lead to similar knock on effect on neonicotinoid use in Kenya, which, though likely only restricted to export growers, is sure to have some beneficial impact on the country's pollinators. Should the PCPB

decide to follow EU's suit and ban this class of chemical for outdoor agriculture, it might spur a shift toward, where possible, more biological pest control options.

Bees As Pollinators Of Agricultural Crops

Pollinators in Kenya include the various types of bees, flies, butterflies, birds and bats. Some of the important cash crops are dependent upon pollinators including the Cucurbitaceae, Eggplant, Passion fruit, mango and so on.

It is well known that papaya plantations in wilder areas produce more, better quality fruit, due to the abundance of pollinators (Hawkmoths) and the reduced distances between habitat and plantation. Many coffee varieties can self-pollinate, but need pollinators for higher yielding and better quality crops. The Robusta variety depends on pollinators.

Bees and other pollinators play an im[portant role in increasing crop yields, food security, as well as in providing key ecosystem services for agrivulture

Crops such as eggplant and tomato are buzz pollinated, so it is important that there are places nearby for pollinators to get nectar, too – such as blocks of bush or forest. Furthermore, pollinators travel long distances, so community level pollinator awareness is required – especially for smaller scale farms.

The Environmental Management and Coordination Act provides an opportunity for communities to conserve areas which provide services such as pollinator habitat for their crops e.g. coffee farmers could apply for protection of forest segments as habitat for pollinators. It is well known that large scale monocultures are linked to poor pollinator populations, and intensive land use has been shown to decrease the number of pollinator species (though the latter does increase the number of individuals).

The use of commercial bee colonies for crops is virtually non-existent here, so wild populations of pollinators are of vital importance to the country's main GDP earner. Despite this, here is no Red List for pollinators in Kenya and the data on the status of pollinator populations in agricultural areas are few and far between

Why Are Bees Dying

Lack of awareness amongst farmers about what their crop's pollinators look like leads to pollinators being mistaken for pests – e.g. spraying what they think are beetles, but are actually pollinating carpenter bees in passionfruit, and thus getting a crop failure.

Carpenter bees are species in the genus *Xylocopa,* which includes ~ 500 bees. The common name "carpenter bee" derives from their nesting behavior; nearly all species burrow into hard plant material such as dead wood or bamboo.

There is a high incidence of blanket spraying – where farmers are routinely spraying their crops with various chemicals, but are unaware of why they do this and what they are targeting. Furthermore, improper spray timing means that many are spraying when pollinators are foraging – i.e. early morning and late evening, and spraying at flowering which is counterproductive.

Spray drift and poor disposal of pesticides means that adjacent wild areas, such as hedgerows, are also affected and therefore poor refuges for pollinators.

Unfortunately, misuse of pesticides in pollinator-dependent crops leads to a decline in crop yield, which is most commonly seen in high value fruit crops. Small studies have shown that conservation of hedgerows and nearby bush or forest blocks as pollinator refuges can contribute to increases in yields of these crops. Coupled with IPM pest management techniques, farmers can see an increase in crop health and productivity at the same time as they reduce their reliance on toxic pesticides.

Pesticide Toxicity to Bees

As farmers and agronomists, it is often uncomfortable to examine the effect of our pesticide spray activities on non-target organisms. Thankfully, it is a question that I am frequently asked when using and recommending insecticides which shows that there is a very genuine concern among growers to minimise the impact of our operations on Bees, beneficial insects and even Earthworms.

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Pesticides vary in the effects on bees. Contact pesticides are usually spread on plants and can kill bees when they crawl over sprayed surfaces of plants or other areas around it. Systemic pesticides, on the other hand are usually incorporated into the soil or onto seeds and move up into the stem, leaves, nectar and pollen of plants.

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Pesticides Safe for Bees

This is an enormous area, and if you will excuse the pun, I could be opening up a 'can of worms' here by suggesting that one chemical is safer than another.

So firstly do not dwell on the specific products below; it is a rough guide to help you understand and manage the risks.

Secondly, there are so many studies involved in toxicology, they may at times conflict in their conclusions. I have summarised the general facts to help to understand the background risks of the products you are applying.

Thirdly, application and use is everything. Applying pesticides at the right time of day, away from Bee hives, using low drift nozzles is as important as the product being applied.

Simple Steps To Protect Bees

Some basic rules can massively reduce the risk to Bees. Makes sure you know where the hives are located and create a buffer zone around them to avoid direct spray drift.

Spray early morning or late evening when the Bees are not foraging in the crop – for Fall Armyworm you should be spraying at these times of day anyway.
Oil based adjuvants can affect the ability of bees to repel water and can significantly increase mortality, even with fairly benign insecticides. So be aware if using them.
Many insecticides contain repellent pheromones designed to keep Bees away from danger. Mixing them with the rest can mask this repellence effect and cause significant Bee mortality. Take care if there are flowering weeds are present in the crop, even if the crop itself is not flowering.

Bonus: What about Earthworms?

Natures' ploughmen as they are often referred can also be impacted by what we spray above ground, but in reality this is to a far lesser extent than above ground species.

It is worth understanding the impact of what we are spraying however, and some of the more risky products will surprise you. It is extremely important to understand both the context and origins of this information. Most studies are compiled in a lab, observing earthworms directly exposed to pesticides on filter paper, and measuring acute toxicity.

In the field earthworms are not likely to come into direct contact with the pesticide immediate at or after spraying, and the chemicals are likely to be at an advanced stage of degradation before the worms pull decaying material into their burrows. Therefore there is a significant difference

between laboratory toxicity and the risk of field exposure. For *chlorpyrifos* which can be persistent for several weeks in the environment there is clearly a risk and this has been measured in field studies. For *acetamiprid* or *lambda cyhalothrin* for example the breakdown is very rapid, hence exposure risk is far lower.

Neonicotenoids are in fact the greatest risk by a long way, but the probability of Earthworms coming into contact with them is very very low.

The fungicide *Carbendazim* however has been acknowledged as posing a high risk, in part due its persistence in decaying plant matter.

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Science Wins as Kenyan Court Dismisses Landmark Case Against GMOs

By Godfrey Ombogo

Kenya is now free to roll out the cultivation and importation of genetically modified organisms (GMOs) after the Environment Court dismissed the case challenging the same. In a judgment delivered on October 12, 2023, the court said the petitioners did not provide evidence that GMOs harm the environment or human health.

"This court has not been shown any evidence to show that the respondents and the institutions named have breached the laws, regulations, and guidelines about GM foods, and in particular the approval of their release in the environment, cultivation, importation, and exportation of Bt maize," said Justice Oscar Angote, who delivered the judgment virtually.

Big win for scientists, farmers and Kenyans

The Law Society of Kenya (LSK) filed the case on January 16, 2023. It was challenging the Kenyan government's October 22 order lifting a 10-year ban on the cultivation and importation of GM crops.

Hon.-Justice Oscar Amugo Angote

Prof. Richard Oduor, Kenya University Biotech Consortium chair and Acting Registrar of Research, Innovation and Outreach at Kenyatta University.

Prof Richard Oduor, the chair of Kenya University Biotech Consortium (Kubico) and Acting Registrar, Research, Innovation and Outreach at Kenyatta University, said he was "overly excited" by the judgment, as it was a big win not just for scientists but also for farmers and Kenyans in general.

"I am thrilled. The farmers will now have the opportunity to sample the technology we have been developing and increase their crop yields," Prof Oduor said on the phone. "I am grateful to the Kenyan government for finally allowing us to see how we can use this technology to benefit us, farmers, and this country." Prof Oduor said the GMO technology has survived for nearly 30 years, and Kenya can borrow a leaf from other countries that have tested its efficacy and safety and adopted it.

"The first GMO product was commercialized in 1994. We cannot be here as a country still discussing a technology commercialized 29 years ago. It's becoming redundant very soon." he said. "There are examples all over the world; there are countries that have used it. At least we have had 30 years, post-release, of understanding this technology and so-called environmental impact."

Done without an Environmental Impact Assessment report

The case raised several issues, including whether GMOs in general and Bacillus thuringiensis (Bt) maize in particular are safe and whether there was public participation before the Cabinet dispatch lifting the ban was released.

There was also an allegation that GM maize cultivation, importation, and exportation were undertaken without an Environmental Impact Assessment (EIA) report.

The court found that the petitioner did not challenge the domestic and international laws governing GMOs and that the regulatory barriers that govern the importation and cultivation of GMOs remain in force and are presumed to be constitutional until otherwise proved. "The evidence before me shows that the country has put in place a robust framework with inbuilt structures, which must be met before

they consider and determine applications for approval of the transfer, handling, and use of GMOs," said Justice Angote.

Intended to guarantee protection

The judge said that in addition to the Biosafety Act 2009 and regulations, the National Biosafety Authority (NBA), which was the second respondent, has adopted guidelines that govern the procedures for environmental release and placing of the market of GMOs, the procedure for receiving, administrative screening and handling GMOs.

"All of these are intended to guarantee protection of the right to a clean and healthy environment," he said.

According to NBA, Kenya has approved 58 GMO projects – 40 for contained use in the laboratory or greenhouse, 15 for confined field trials, and three for environmental release or commercial cultivation.
The three that have been approved for commercial cultivation are Bt cotton, which was commercialized in January 2020; *Bacillus thuringiensis* (Bt) corn,

which was approved by NBA in October 2022 and is now awaiting submission to the National Variety Release Committee (NVRC); and virus-resistant cassava, which is undergoing National Performance Trials by the Kenya Plant Health Inspectorate Service (KEPHIS).

Developed and approved

Four varieties of Bt cotton have been recommended for release by the National Performance Trials Committee (NPTC). At the same time, six have undergone NPT and Distinctness, Uniformity, and Stability (DUS) testing, but the court case had slammed the breaks on their release.

With the court case now settled, scientists and the National Biosafety Authority now have the authority to release the variety of GM crops that have been developed and approved and create more as the country struggles with food security challenges. One more consolidated case by lobby groups is still pending before the High Court.

In Africa, at least ten countries have GM crop approvals, with South Africa approving GM cotton, corn, and soybeans, and Nigeria, Ethiopia, Kenya, Sudan, Eswatini, and Malawi allowing pest-resistant cotton, cowpea, corn, and brown streak virus-resistant cassava.

Dr. James Karanja, a research officer from Kalro, says the TELA Bt corn is the answer to Kenya's food insecurity situation because it has a guaranteed yield of 10 more bags per acre without pesticide use. It also assures quality grain and reduces aflatoxin contamination. "Corn production in Kenya has decreased by 35 percent from 2018 to 2022 because there is no insect- or pest-tolerant variety in the market," said Dr Karanja during a recent meeting between Kenyan editors and biotechnology experts in Nairobi.

Dr. James Karanja of KALRO

Collaborate closely with the Department of Public Health

According to the Food Security and Nutrition Analysis Unit (FSNAU), food insecurity is a recurring issue, with 3.2 million Kenyans in the arid and semi-arid regions facing high levels of acute food insecurity as of September 2022.

According to a report by the Alliance for Science, in 2018, 18 million farmers in 26 African countries chose to grow GM crops, which helped to reduce poverty and hunger by benefitting more than 65 million people. Justice Angote urged Kenyans to trust the institutions put in place and call them to order if they breach the law.

"The Biosafety Act stipulates that the National Biosafety Authority should collaborate closely with the Department of Public Health, which safeguards consumers' health through food safety and quality control," said the judge.

Godfrey Ombogo is an editorial consultant, consulting science editor, and writer for Media for Environment, Science, Health and Agriculture (MESHA) in Kenya.

The Truth About GMO Research

In a bid to address misinformation and unfounded claims about GMOs, Alliance for Science had a one-on-one interview with Dr Martin Mwirigi, the Director of the Biotechnology Research Institute at the Kenya Agricultural and Livestock Research Organization (Kalro), to help shed more light on Kenya's journey in biotechnology.

"Genetic modification through the natural process started a long time ago. Biotechnology is trying to use what happens naturally and fast-track it."

Kalro is the body tasked with carrying out agricultural research by applying science, technology, and innovation.

Interestingly, Dr Mwirigi started at Kalro (then called Kari) biotechnology center as an intern and rose to become a director. "I was the first student on an internship at Kari Biotech Centre in Kabete. The center was carrying out research on tissue culture, and there was a lot of research on the development of livestock vaccines. That was in 1996," says Dr Mwirigi.

In 2013, Kari merged with Coffee Research Foundation, Tea Research Foundation, and the Kenya Sugar Research Foundation (Kesref) to form Kalro.

There are 17 research institutes under Kalro, including the Biotechnology Research Institute, which Dr Mwirigi heads.

With the institutional transformations, the organization was gearing up to delve deeper into biotechnology research, with trials on tissue culture going on in its laboratories. Tissue culture is a part of plant biotechnology.

Early days of natural breeding

To break down the science behind biotechnology, Dr Mwirigi says the journey started around 8000 BC when humanity began domesticating animals. "Genetic modification through the natural process started a long time ago. Biotechnology is trying to use what happens naturally and fast-track it. In genome editing, genes are made of building blocks, which are the same in all living things," he says.

Dr. Martin Mwirigi, Director of the Biotechnology Research Institute at the Kenya Agricultural and Livestock Research Organization.

"Back then, our ancestors would spot the animals with the best traits and use them for breeding. They did that over the years to get the best breeds to rear and multiply." Corn, the staple food in Kenya, has also gone through years of breeding that started with the dwarf variety with low yields to the current ones that are taller and high yielding.

Drought-tolerant corn at the Kenya Agricultural and Livestock Research Organization's Kiboko Station.

"In the history of corn, the original version was significantly smaller but productivity has increased thanks to natural selection and conventional breeding. Genetic modification happens every time there's an improvement in traits. Traits are inherent in the genetic makeup," Dr Mwirigi says. Researchers borrowed from indigenous knowledge to seek solutions for global issues linked to population growth and changing climatic conditions.

Fall Army Worm

Kalro Director General Dr Eliud Kireger says climate change, pests such as the fall armyworm and maize stalk borer, and diseases such as maize lethal necrosis threaten food, feed, and nutritional security.

"These pests are costly to control, with farmers spending up to 85 dollars per acre on pesticides alone. These pesticides also harm human health and the environment, especially water," Dr Kireger points out.

"You can still use ash to control stem borer in your small farm, but if you are a large-scale farmer, ash is not sustainable nor practical. You are forced to use expensive pesticides to protect your corn."

The Food and Agricultural Organization says that due to climate change, plant pests that ravage economically essential crops are becoming more destructive and

threaten food security and the environment.

The challenge of maize stem borers.

Dr Mwirigi agrees that about 15 years ago, there were no stubborn crop pests like stem borers that cause considerable losses to maize farmers.

"Our grandparents did not face issues like stem borer attacking their maize. If pests hit the farms, they would use simple solutions like applying ash on the crops, which worked.

"You can still use ash to control stem borer in your small farm, but if you are a large-scale farmer, ash is not sustainable nor practical. You are forced to use expensive pesticides to protect your corn," he says.

Worrying food situation

For food-insecure countries like Kenya to achieve food and nutrition security, there is a need to embrace agricultural biotechnology.

Latest data shows a likely unprecedented deterioration in Kenya's food security situation, with over 5.4 million people experiencing acute food insecurity which year and likely to deepen.

Additionally, it is estimated that around 4.4 million people — 27 percent of the population in arid and semi-arid lands — are facing high levels of acute food insecurity. With these new challenges that farmers face, technology has to change, which led researchers to develop Bacillus thuringiensis (Bt) corn.

The science behind Bt corn?

"Apart from National Biosafety Authority, other regulatory institutions must approve the cultivation and consumption of GM products in Kenya."

Bt corn is genetically engineered to express insecticidal proteins from the bacterium *Bacillus thuringiensis*, which produces toxic proteins to certain insects.

"Bt bacteria are abundant in the soil. We eat it on a typical day. Bt bacteria feeds on the larva stage of stem borer. It was

Corn field

a breakthrough moment when scientists understood that the bacteria is toxic to maize stem borer.

-"To develop insect-resistant corn, they inserted a small portion of the gene from the bacteria into the corn. That is how we develop Bt corn, which is resistant to maize stem borer attacks," Dr Mwirigi says.

Safety and ethical concerns

With such editing and inserting of a bacterial gene into corn, the question arises: is that corn safe for human consumption? Won't the same bacteria that kills stem borers kill humans, too, when they consume Bt corn?

Dr. Mwirigi's answer is a resounding "No."

"First, from history and research, this is bacteria that humans have encountered before because it is in the soil, and its larvae have no receptor in the human gene."

To guide the development and safe administration of GM crops in Kenya, the government developed and approved a national policy on biotechnology in 2006. This later led to enacting the Biosafety Act in 2009, which led to the formation of the National Biosafety Authority (NBA) in 2010. The NBA is a State agency tasked with ensuring the safety of human and animal health and providing adequate protection of the environment from harmful effects that may result from genetically modified organisms.

Regulatory institutions

Apart from NBA, other regulatory institutions must approve the cultivation and consumption of GM products in the country.

First, there is the Kenya Plant Health Inspectorate Service (Kephis), a State agency responsible for assuring the quality of agricultural inputs and produce.

The National Environment Management Authority (NEMA) also aims to promote and ensure sound environmental management practices for sustainable socio-economic development.

Further, there is the Kenya Bureau of Standards (Kebs), also a State agency whose duty is to promote standardization in industry and commerce. With all these checks and balances guiding the development of GMOs in Kenya, Dr Mwirigi says GM crops are safe for human consumption, and Kenyans should not be worried.

Bt Cotton

Asewe Hellen is a multimedia journalist from Kenya with more than ten years of experience reporting on the environment, health, and agriculture. She is a 2023 nominee for Annual Journalism Excellence Awards in the Environment and Climate Change Reporting Award category.

Climate Change, Post-harvest Losses and Food Wastage Mark World Food Day Celebrations

By Marko Phiri

As the World Food Day was marked on October 16, 2023, millions worldwide were starving and global food wastage is yet to ease.

According to agencies, food worth billions of dollars goes to waste annually due to poor post-harvest storage and food that has made it to the table but is later dumped as leftovers.

Rich countries, the world's major food producers, have been identified as culprits as the Global South struggles with food insecurity. The World Food Programme (WFP) says hundreds of millions of people in developing countries require food assistance despite evidence that global food production remains enough to address such humanitarian emergencies.

According to the WFP, global hunger is worse than ever, with a third of food produced for human consumption going to waste. For perspective, the Food and Agriculture Organization (FAO) estimates annual global food wastage at 1.6 billion tons. And the numbers remain staggering. "In just two years, the number of people facing, or at risk of, acute food insecurity increased from 135 million in 53 countries pre-pandemic to 345 million in 79 countries in 2023," WFP says.

Recovering from the devastation brought by Covid-19

On the other hand, in the run-up to International Day of Awareness of Loss and Waste, the United Nations had another set of upsetting statistics: "13 percent of produced is lost between harvest and retail, while 17 percent of total global production is wasted in households, in the food service, and retail."

This year's World Food Day comes against the backdrop of countries still recovering from the devastation brought by COVID-19, which disrupted agricultural activity and food production. "Fueled by conflict, climate shocks, and COVID-19, the crisis is escalating as the war in Ukraine drives up the costs of food, fuel, and fertilizers. Millions of people are struggling to put food on the table and are being driven closer to starvation in a storm of staggering proportions," the agency adds in a 2023 donations appeal.

While the Russia-Ukraine war has been blamed for putting the brakes on global food distribution networks, analysts note that beyond wastage, climate change remains a major challenge in food production. "The return of El Niño this

year will exacerbate extreme weather events and lead to record-high global temperatures in some geographies, impacting crop yields in the 2023-24 growing season," said Tanya Bahita, research analyst at the Economist Intelligence Unit. "Climate change continues to pose long-term threats to food security with significant potential impact on crop productivity."

Post-harvest losses

There are concerns that future World Food Day commemorations will likely face the same global challenges to meet its goals unless clear and present dangers are addressed. Developing countries have struggled with post-harvest losses amid concerns that poor storage technologies have worsened food wastage and food insecurity, leaving millions requiring aid assistance. "The financial costs of food wastage amount to more than one

trillion dollars each year. The World Food Programme is extremely concerned as this is a challenge we must solve as we work towards achieving Zero Hunger," said WFP spokesperson Tomson Phiri. "On World Food Day this year, some 345 million people are facing acute food insecurity, and the humanitarian system is struggling to keep pace with the needs."

In 2021, the Barilla Center for Food and Nutrition Foundation, a think tank that tracks global food consumption trends, found that up to 690 million are food insufficient. The agency further found that between 83 and 132 million more would face the same fate of the undernourished due to COVID-19-induced food production interruptions.

Connected food wastage to climate change

While global COVID-19 restrictions have eased, the lack of access to food and quality nutrition has not. The World Bank has noted rather alarmingly that in 2021, 3.1 billion people across the globe could not afford a healthy diet. This was an increase of 112 million more people from 2019, the World Bank said in July this year. Despite the food deficits affecting millions, the 2021 Barilla report said child and adult obesity is on the increase in developed countries. The United Nations Environment Program has connected food wastage to climate change. It has been estimated that between eight and 10 percent of "global greenhouse gas emissions are associated with food that is not consumed."

The Food and Agriculture Organisation officially declared World Food Day in 1979, and while this year's theme is Water is Life, Water is Food. Leave No One Behind, it is continued food wastage that will bring the paradox of world hunger to this year's commemorations. "There is enough food to feed everyone on the planet. Conflict, the climate crisis, and economic instability are putting unprecedented stress on the world's food systems," Phiri said.

Marko Phiri is a Zimbabwe-based journalist writing on the intersection of climate change and development in Africa.

Pictorial: Corteva Agriscience Unveils TarzecTM 320WG

Mr. Innocent Oeri, Corteva Agriscience Marketing Campaign Manager

Francis Karanja, the Corteva Agriscience Sales Manager ESCA

Stephen Nderitu, Territory Sales Representative

Mr. Stanley Maina, a farmer and a freelance consultant

A group photo

Farmers follow Mr. Oeri's presentation Keenly

Brenda Muthoni of Sunrise Agrovet

Mr. Anampiu explains to Mr. Eli, a farmer from Kisima area how Tarzec works

Mr. Wachira, a farmer from Nyeri

Mr. Francis Karanja awards a farmer

Joan Mbuva, Marketing Specialist assists in Registration

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