



Photo: TOF

Joel Cheringit, a farmer in Chemaner area in Bomet County shows the size of potatoes that he is expecting from his farm following the invasion of whiteflies in the region. Many farmers in Bomet County have incurred huge losses due to whitefly infestation in the entire County. (Page 3)

Dear farmers,

Just a year after we reported the invasion of *Tuta absoluta*, one of the most destructive tomato pests, we again report the invasion of a new pest into Kenya, the potato cyst nematode (*Globodera rostochiensis*).

Like *Tuta absoluta*, the potato cyst nematode is very destructive and cannot be eradicated easily when it infests a farm. Besides this, the nematode has no known cure and can last in a farm for up to 30 years.

Potato, which is the second most important food crop in the country after maize faces other problems in its production, including spread of bacterial wilt and lack of certified seed. In the last few years, TOF has expressed concerns on the effectiveness of inspection of plant material at Kenya's points of entry.

For potatoes, the Kenya Plant Health Inspectorate Service (KEPHIS) requires that any seed imported into the country must be in the form of *in vitro* plantlets (brought under laboratory confinement). Such material should be immediately transferred to Plant Quarantine Stations (PQS) where they should be screened for any diseases or pests before they are put under performance trials and released only if they pass all the tests.

This requirement is part of seed certification process and standards, which are specified in The Seeds and Plant Varieties Act, CAP 326 of the Laws of Kenya. Unfortunately, these regulations have not been followed as powerful and unscrupulous individuals have influenced the importation of whole potato tubers into the country.

It is critical for farmers to ensure that the nematode does not spread to other potato growing areas. This precaution is necessary because many farmers rely on their neighbours for seeds.

It is also very important that farmers use only certified or quality-declared seed for planting, practice crop rotation and proper hygiene and avoid planting in infested farms to prevent spreading of pests and diseases.

In developed countries, an immediate quarantine is imposed to ensure no potatoes leave the affected region wherever the pest is discovered. We hope this can be done in areas like Nyandarua, which supplies more than 40 per cent of the country's potatoes.

New pest threatens potato production in Kenya

TOF - Kenya has been invaded by a new potato pest that threatens to cut production by more than 80 per cent unless urgent measures are taken to control it. Although the pest has been identified in a few countries in North and West Africa, and in Europe, North and South America where it is strictly con-

trolled through quarantines, this is the first time the pest is being reported in East Africa.

Pest is resistant to pesticides

Potatoes and soil samples taken from several sites in Nyandarua County, and tested in Kenya and Germany have confirmed the presence of potato cyst nematode (*Globodera rostochiensis* or *G. rostochiensis*). The region produces more than 40 per cent of the potatoes produced in Kenya.

Persistent in soil

There is no pesticide chemical or biological that is known to control the pest. The only control measure is to stop potato production in infested farms for up to 7 years. The pest, however, can remain in the soil for more than 30 years.

The potato pest may spread fast to other parts of the country because more than 90 per cent of potato growers in the country buy seed from neighbours. Many farmers in Nyandarua county also sell potato seeds to farmers in other parts of the country, increasing the possibility of rapid spread of the pest to other potato growing areas.



Globodera rostochiensis

Potato imports to blame

Scientists at KALRO have in past lodged complaints after discovering that some varieties of potato seed had been imported into the country without stringent checks by the Kenya Plant Health Inspection Service (KEPHIS) - read TOF No.106, March 2014. The infested seeds have the potential to introduce new diseases and pests into the country (Page 2).

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What farmers need to know about new potato pest

Potato cyst nematodes are among a species of harmful nematodes that specifically target potatoes and other crops in the potato family such as tomatoes, pepper, eggplant, and black nightshade.

Peter Kamau | Nematodes are slender worms that the naked eye cannot see unless when placed against a light. They are usually one millimetre in length and are cylindrical (long and round like an earthworm).

Although potato cyst nematodes are indigenous to Peru and other regions with low temperatures in Europe, where potatoes have been cultivated for thousands of years, the pest has been confined to particular regions where it is prevented from spreading through quarantines. This has left many potato growing areas in the affected countries free of the nematodes.

In Africa, potato cyst nematodes have been reported in Northern African countries including Algeria, Egypt, Libya, Tunisia and Morocco (under quarantines). Other countries where the pest has been reported are Sierra Leone and South Africa where they are also controlled.

Potato imports responsible for spread of pest

Kenya can only produce 2 per cent of the required certified potato seed, limited to this fol-



Photo: JN

lowing the grabbing of land meant for research and potato seed multiplication, among other challenges. Scientists at the Kenya Agricultural and Livestock Research Organisation (KALRO) have noted with concern that some varieties of potato seed had been imported into the country without stringent checks by the Kenya Plant Health Inspection Service (KEPHIS). These have the potential to introduce new diseases and pests into the country (*read TOF No. 106, March 2014*).

Any seed variety imported into Kenya has to undergo screening and quarantine protocols. This is meant to ensure the seeds do not introduce diseases and pests that could affect potato production.

How can farmers identify potato cyst nematodes?

It is not easy for farmers to identify potato cyst nematodes infestation in their potato crop. This is because potato cyst nematodes are very small in size and thus not easily visible to the naked eye. Infested potatoes show the same symptoms caused by other diseases and pests such as stunted growth, yellow or wilted leaves. The potato plant may develop tiny tubers and sometimes no tubers at all.



Photo: JN

Potato cysts nematodes (brown) in a potato root system.

How can farmers control potato cyst nematodes?

So far there is no known chemical or biological pesticide that controls potato cyst nematodes. In countries where the pest has been identified, the most effective measure has been to ensure that no potatoes from the affected areas are transported or sold in the market both for food or as seeds (this restriction by the government or local authorities is called a quarantine). Farmers in areas where the pest is found are not allowed to grow potatoes but are instead encouraged to grow other crops that do not belong to the potato family. Other measures that farmers can take to keep the pest from their farms include:

- Using certified potato seed at all times in their farms and not seeds bought from neighbours or those from unknown sources.
- Using quality declared seed from known potato seed growers.
- All farms where the potato cyst nematode is identified should not be planted with potatoes for up to 7 years. Potato cyst nematodes can remain in the soil for up to 30 years; land remaining free of potatoes for seven years has less infestation of the nematodes.

- Farmers are also encouraged to practice crop rotation at all times to reduce the population of potato cyst nematodes in their farms.

- Affected land can also be left to remain fallow for 7 years, if possible. This is, however, a challenge in Kenya because land sizes are very small and farmers need the land to grow other food crops.

- Potato varieties resistant to potato cyst nematodes can be developed. This needs years of study for research institutions to identify and get certification for resistant varieties.

How was the potato cyst nematode discovered?

Between August and October 2014, potatoes and soil samples were taken from several sites in Nyandarua County and tested in Kenya and Germany. Scientists have confirmed the presence of potato cyst nematode (*Globodera rostochiensis* or *G. rostochiensis*) in most areas in the county.

James Maina Mwangi, currently an assistant lecturer at Department of Biological Sciences at Chuka University, was sampling farmers' fields in Nyandarua County in the search for nematodes that affect cabbages for his MSc. thesis, when he came across cysts that resembled those of *Heterodera species*. As a follow up, he went back and sampled both cabbage and potato farms and extracted more cysts.

"It was then that I consulted my supervisor whereupon we did a detailed molecular analysis (in Kenyatta University Laboratories and DNA sequencing by Inqaba Biotech in South Africa). We discovered that the species we were handling was *Globodera rostochiensis*. To confirm our findings, we sent the samples to our colleague in Bonn, Germany," he says.

The results of the external

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The Organic Farmer is an independent magazine produced monthly for the East African farming community. It promotes organic farming and supports discussions on all aspects of sustainable development. The articles in the *The Organic Farmer* do not necessarily reflect the views of ICIPE.



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Whiteflies destroy potatoes in Bomet County

Farmers count losses as whiteflies invade their farms. However the effect of long-term use of chemicals is likely to blame for increase in pest.

The Organic Farmer | The invasion of potato fields has led to huge losses by especially for farmers who are contracted by potato crisps processing companies in Nairobi to supply the Dutch Robyjn variety of potatoes.

Young whiteflies (at nymph stage) stick to the underside of potato leaves where they suck water, making it difficult for leaves to make and transfer nutrients to the plant, which interferes with the growth of potato tubers.

Production goes down

Farmers interviewed in Chemaner and Kipsigor in Bomet county told The Organic Farmer that this is the first time the region has experienced the invasion of whiteflies, which have destroyed entire potato farms and left farmers with little or no crop to harvest.

Climate change, chemicals to blame for pest

An increase in pests and their resistance to chemicals is one of the major problems that farmers in Kenya are presently facing. For many years, farmers have tended to rely on chemicals for pest control. As a result, the pests have developed resistance to most of the chemicals in the market.

Resistance is a natural mechanism adopted by pests as a way of survival. The pests develop resistance traits that enable them to overcome chemicals that are commonly used to control them. To stay ahead in the fight against pests, chemical companies develop new chemicals every year that have new formulations to kill the pests.

Chemical kill beneficial insects

But most of the chemicals being used have serious side effects, which many farmers do not understand. One of these side effects is that the chemicals also kill other beneficial insects that control the pests naturally.

For example, farmers interviewed in Bomet indicate that one of the major chemicals they have been using to control the



A farm devastated by whiteflies in Bomet County. The potato crop has failed in many farms.

Joel Cherinyit, a farmer in Kapsigirior said he harvests an average of 70 bags of potatoes in his one and a half acre every season. This season he did not harvest anything due to the whitefly damage although the rains were adequate this year.

"I have been growing potatoes for 20 years but I have never seen anything like this," says Cheringit.

He says many farmers had taken loans to enable them grow

potatoes as they did every year, but would find it difficult to repay the loans and meet other household needs like school fees for their children.

Chemical control has failed

Michael Towett, another farmer from Kapsigirior says he gets an average of 55 bags of potatoes per acre but he only harvested 11 bags this season.

"We usually deliver 10 tonnes

of potatoes to Norda industries in Nairobi every week, but last week I delivered only 900kg. Potatoes are our main source of income since we no longer grow maize due to the damage caused by the Maize Lethal Necrosis (MLN) disease. Most of the farmers interviewed said they had tried all known chemicals to control the whiteflies without success. Most of the farmers have now given up and asked the government to assist them in controlling the pests.

A simple way to control whiteflies

Whiteflies are very difficult to eradicate once they establish themselves in a crop. The following simple methods to keep them under control and protect their crops:

1. Mix 20ml of hydrogen peroxide with some little water. Add the mixture to a 20-litre knapsack sprayer filled with water.
2. Add 20ml of liquid cooking oil into the knapsack.
3. Spray the potatoes all over the potatoes, including the underside of the leaves where the nymphs (young whiteflies) attach themselves and sap juice from potato leaves.
4. Hang yellow plastic papers smeared with used engine oil all around the edges of the potato shamba (at least 1 metre above the ground), the yellow attracts the whiteflies and once they land on the polythene paper, they get trapped by the oil and cannot leave.
5. Do not wait until your shamba is invaded by whiteflies before taking the above measures- spray the garden before any whiteflies attack the crop.

- Remove all the polyethylene papers with used engine oil and discard them safely to keep your



Young whiteflies (at nymph stage) stick to the underside of potato leaves where they suck water, making it difficult for leaves to make and transfer nutrients to the plant, which interferes with the growth of potato tubers (below).



environment safe. Remember, prevention is easier than cure!

For more information on Organic pest and disease management refer to Infonet-Biovision website: <http://www.infonet-biovision.org/default/ct/128/crops>

Farmer who has made TOF his farming bible

Since he came across his first copy of *The Organic Farmer* magazine, Joab Marrow has religiously put into practice what he has learnt, not only increasing his crop yields and income but also training other farmers.

Peter Kamau | Three years ago Joab Marrow, a farmer from Nzoia Scheme attended a field day organized by Star Rays Education Centre in Likuyani Division of Lugari District in Kakamega County. During the field day, he came across tissue culture bananas and developed an interest in growing them.

At the centre, Marrow came across past copies of *The Organic Farmer* magazine. From the magazine he learnt more about tissue culture bananas and even got the contact of Jomo Kenyatta University College of Agricul-

ture where he could buy tissue culture banana seedlings. He also attended a training session on how to grow them. After the training, he immediately placed an order for 143 seedlings, which, he planted. The bananas did well and within a year, he ordered an additional 80 seedlings.

Within a short time, marrow had established himself as a successful banana farmer. Farmers from neighbouring farms flocked to his farm to buy tissue culture banana seedlings and learn more about banana production and other agricultural enterprises.

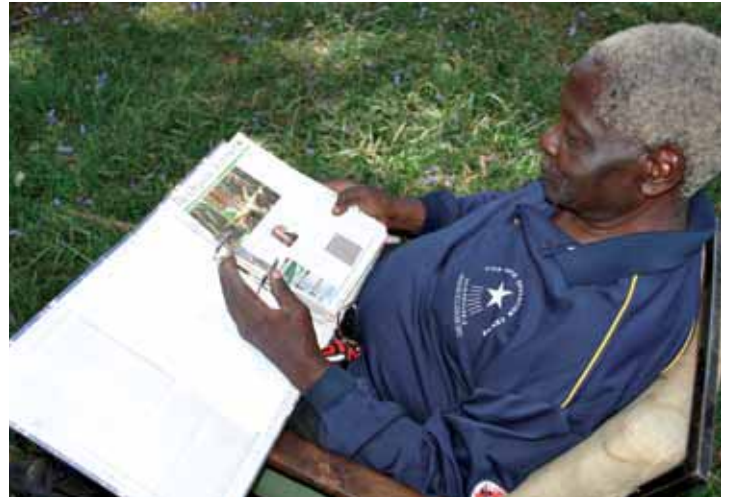
Due to his knowledge on banana production, the Kenya Agricultural and Livestock Research Organisation (KALRO, formerly KARI) Kitale have made his a model farm where they train other farmers on tissue culture banana production among other enterprises.

Read and adopted conservation agriculture

Marrow receives every monthly issue of *The Organic Farmer*, which he carefully files for future reference. Using the various technologies and information obtained from the magazine, Marrow has become an expert farmer and trainer. Farmers now consult him on every problem they encounter. Agricultural institutions have also recognized his interest and passion for farming and are now using him to train other farmers in the region.

When Marrow read about the benefits of Conservation Agriculture (CA) in *The Organic Farmer* magazine, he bought a job planter and a ripper and used the method in maize production last year, "through this method I have managed to increase my maize production from the 8 bags I was harvesting previously to 15 bags from one acre in 2014. My target in 2015 is to get at least 35 bags," he says.

Last year, the Participatory Approach For Integrated Development- Conservation Agriculture Regional Programme (PAFID-CARP), a regional organization that promotes conservation agriculture in East and Southern Africa wanted to find a model farmer who has adopted the practice, they were directed to Marrow's farm where they were so impressed with what he was doing that they donated an ox-drawn ripper that he intends to use this year for in land preparation.



Joab Marrow files every issue of TOF magazine for future reference.

On realizing that banana price were not giving farmers good returns, The Ministry of Agriculture, Livestock and Fisheries has come in through the Kenya Agricultural Productivity Project (KAPPAP) has stepped in to train farmers on marketing of their agricultural produce and value addition. Instead of selling bananas in bunches, the farmers have been trained to sell fingers and even do value addition such as preparation of banana crisps.

Formed CBO and a SACCO

Together with other farmers in the, Marrow has registered Sinoko Development Organisation, A CBO that aims at educating farmers in the region on modern farming methods that will help increase yields and income.

"We have discovered that we can be able to uplift the earnings and standards of living for the majority of our members by training them on various agribusiness enterprises such as banana production, rearing chickens and dairy farming" he adds.

Plan for value addition

To this end the farmers have formed the Likuyani Mwangaza SACCO that will encourage farmers to save their earning from various agricultural enterprises.

The SACCO already has 400 members drawn from Likuyani and the neighbouring counties of Trans-Nzoia, Uasin Gishu, Bungoma and Kakamega.

The farmers plan to set up processing plants for their farm products to add value and increase earnings for their members.

Centre of learning

Star Rays Education is supposed to be a private primary school when it was established in 2015. But it is set upright at the centre of Wekhomba in Kongoni area of Likuyani division, in a rich agricultural area. At its inception, farmers from the village would come to the school to consult the Founder director Mr. William Makechi, who is also a livestock extension officer by training. It is then that an idea hit him that he could set up a Farmers Resource Centre mainly as part of his social responsibility to help the community.

From this humble beginning the centre has grown to become a major point of learning for farmers. Every second Saturday of the month, farmers from all over Likuyani division and beyond converge here to learn every aspect of farming be it dairy farming, beekeeping, poultry or any other area of their interest.

The government, NGOs and experts from various fields come to the centre to train farmers on crop production, livestock or even human health.

Farmer get practical training

During the training, farmers have the opportunity to learn through video shows, and practical lessons in the centre's demonstration plot. They also read various agricultural journals including *The Organic Farmer* magazine. International volunteers also offer various training programmes to pupils, farmers and the community on various topics.



Crops grown on contaminated water a health risk

Some of the vegetables and fruits you buy from roadside kiosks may have been grown in the sewage, contaminated water or grown using harmful chemicals putting your health at risk.

Trotsky Lumiti | You visit your neighbourhood kiosk almost daily for your regular supply of *sukumawiki* (kales), terere (amaranthus), suchas (black nightshade), spinach, tomatoes and other vegetables and fruits. But do you ever bother to ask the vendor where they buy their supplies or even how they are grown?

All over the world, consumers, aware of the risks of eating contaminated food, are beginning to make enquiries on the source of the food they eat and how it is grown, handled and transported to the market. And they have a good reason to be concerned. Research shows that consumers are prone to diseases such as cancer, diabetes, high blood pressure and other complications due to poor quality food.

Vegetable farming in urban areas

With increase in urban population in towns such as Nairobi, which now has over 3 million people, the demand for food has increased. In order to meet the demand, some vegetables are transported from the rural areas to the towns where they are sold in various markets. The quantities are, however, often not sufficient. This has led to establishment of urban farms.

There being limited space in town to practise agriculture, as most of the land is used for settlement, farmers have opted to farm on the road side, on river banks or on gunny bags. While some farmers depend on the unpredictable rainfall to water their crops, others irrigate their crops with waste water which contains higher than the maximum allowable levels of pesticides, herbicides, harmful bacteria and heavy metals like



lead, which are harmful to humans and animals. This situation has been caused partly by lack of fresh tapped water, which is either too costly or unavailable to urban farmers.

Source of vegetables in the market

Most of the agricultural products in Nairobi are obtained from the rural areas and sold to vendors in markets such as the Wakulima market. Vegetable vendors purchase the vegetables and redistribute it to the estates.

Supermarkets in several parts of the country have included agricultural products on their shelves. Conrad Muindi who works in one of the major supermarkets in Nairobi, says that most of the vegetables sold in the outlet are obtained from Limuru in Kiambu County. Peter Mule, a farmer and trader, says that he harvests his products and supplies from his farm in Limuru, then sells them to different supermarkets in Nairobi.

Besides supermarkets, most Nairobi residents obtain their vegetables from the vendors in the estates. Corner market, situated in Kayole estate, is well known for the various agricultural products sold to its community. The products range from kales (*sukumawiki*) to tomatoes, cabbages and onions. Although most of the products were bought from Wakulima market, the largest agricultural market in Kenya, some vendors buy their supplies from farms in the neighboring estates such as Kamulu and Ruai, which are known to have water supply problems.

Some traders conceal source of their vegetables

Research by TOF revealed that it is difficult to get information from traders and vegetable

vendors on the source of the vegetables supplied to the market. Some do not acknowledge their sources for fear of losing their buyers. This has made it difficult for residents in Nairobi and other emerging towns to know the sources of the vegetables, fruits and the other agricultural produce. Many unknowingly purchase fruits and vegetables that may have been contaminated during the production or transportation process.

Waste water irrigation

Nairobi River passes through highly populated estates with poor drainage systems. The waste water from the river is used for irrigation and this has led to the emergence of farms along the riverbank. Most of the water in Nairobi River has, however, been polluted as a lot of untreated sewage and waste water end up in the river.

Farmers grow vegetables along the mucky Nairobi river

In Njiru and Ruai areas, farmers are growing various crops including vegetables along the river, using the water from Nairobi and Ngong rivers, into which raw sewage and untreated waste water are disposed. Nairobi river flows through Mathare, Korogocho, and Dandora slums which have poor waste disposal and sewage systems.

Material from dumpsites end up in river

Dandora, particularly, is home to a 30-acre dumpsite that contains industrial wastes such as fall-offs, used chemicals, raw materials, expired products and substandard goods, agricultural wastes such as fungicides and herbicides, as well as hospital waste like packaging materials,

and containers, used syringes and other sharp, biological waste and pharmaceuticals. These are washed into Nairobi river during the rainy season.

Without knowing the dangers of the polluted water source, Robert Gatelo, a farmer in Ruai, grows spinach, kales, and the amaranthus (terere) on his half an acre plot.

"After a good harvest, I can make up to Ksh15,000 monthly," he says as he continues to tend to his vegetables. His farm is located just beside Nairobi river, which was the main source of irrigation water. The water from the river is mucky and heavily polluted. On being asked about the quality of the irrigation water, he says: "This is not sewage, this is Nairobi River," he says as he points at the dark colored water. "The water has just been polluted that is why it has the dark colour."

Level of contamination high in Nairobi rivers

Studies done by researchers in Kenyatta University have revealed that the water in Nairobi and Ngong rivers is not safe for human consumption or for farming. This is because the water contains heavy metals like Iron, Manganese, Lead, Copper, Cadmium and Zinc above the limits set by the National Environmental Management Authority (NEMA). NEMA regulations are specified in the Environmental Management and Co-ordination (Water Quality) Regulations, 2006.

Harmful bacteria

Due to discharge of untreated waste water, sewage and industrial waste, the rivers also contained harmful bacteria such as *Escherichia coli* (causes diarrhoea, urinary tract infections, respiratory illness and pneumonia), *Salmonella paratyphi* (causes Typhoid) and *Vibrio cholera* which causes Cholera. The public health standard for drinking water quality states that no harmful microorganisms like *Escherichia coli*, *Shigellae*, *Pseudomonas aeruginosa* or coliforms should be detectable in drinking water.

Consumers cannot detect contamination

When, polluted water is used for



Farmers in Kakamega access loans on phones

Farmers now can not only be able to save their money using the mobile phone, they can also transfer money and request for loans whenever the need arises.

Elkana Isaboke | Did you know that commercial lending to agriculture is 1 percent of all lending in Africa? According to Campaigne and Rausch (2010), financial access in rural areas remains very small and agriculture in particular has been underserved. Across developing countries, in urban and rural areas, access to and use of formal finance remains very low in general.

ICT the way to go

However, application of Information and Communications Technology (ICT) in agriculture is increasingly becoming important. Consequently, e-agriculture is an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-Agriculture

involves the conceptualization, design, development, evaluation and application of innovative solutions in the rural domain, with a primary focus on agriculture.

In Kenya, small-scale farmers are the country's largest group of rural poor. Much of the food supply will continue to depend on their efforts, yet a lack of financial services often undermines their attempts to make productivity-enhancing investments and to smooth their consumption between periods of plenty and food deficit spells. Farmers without capital minimize risk instead of maximizing returns.

Safaricom provided mobile service

The key kinds of financial services that farmers need in order to achieve their economic goals are credit, savings, transfer and payment. Faced by these challenges, farmers in Kakamega County came together under the umbrella of Kakamega Rural Development Programme (KARDEP) Community Based

Organisation (CBO) approached Safaricom Ltd and they were provided with a customized solution to enable them make savings, transfer and make payments and they can access credit based on their savings on the platform through their mobile phones.

Farmers need only an ID card and a mobile phone

Michael Wangalwa
one of the founders



explained that using a special number provided by Safaricom and their IDs account numbers, farmers can now access credit based on their savings and also on condition the money will be invested

in agriculture.

This has helped many farmers who in the past could not afford inputs and funds to prepare their land. At the beginning of the growing season, they also needed capital to invest in equipment such as drip irrigation and to harvest, process, market, and transport their produce but could not afford.

Farmers now able to save

Abnery Amwai noted that thanks to the platform, he has been able to save. He said saving is critical to them because their income is seasonally tied to the harvest, and for much of the year, they rely on savings to make financial transactions.

'It is safer to carry money in my phone than having cash. I have therefore started accepting people who pay via this system to avoid the risk of losing my money.' Another farmer said. This follows many reports of farmers who have lost thousands of cash in market places after selling their cows or chickens. With this new platform in the area, many farmers have benefitted and many more will as the CBO grows. ■

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potato cyst nematode



analysis confirmed that it was indeed *Globodera rostochiensis* or potato cyst nematode that had been discovered. Mwangi presented a paper on the same at Kenyatta University on December 3, 2014. Potato cyst nematodes were found in all the areas that were sampled in Ndaragwa, Ol joro orok, Ndun-dori, Ol Kalou, North and South Kinangop.

Farmers in the affected areas said they had sourced their potato seeds from other growers in different parts of Nyandarua county.

Although the potato cyst nematode is mainly found in

Europe and a few African countries where it has been confined (quarantined) to prevent its spread, farmers in the country are surprised at the discovery of the new potato pest in Kenya: "The maize disease (*Maize Lethal Necrosis*) has destroyed our maize crop last season. I did not harvest anything because my maize crop wilted before it could form the cobs.

Now the potatoes are also affected by the new pest. We do not know what to grow next because these are the two main crops we grow here for food and sale," says Shadrack Thiongo, a farmer from Mirangine, Tumaini in Nyandarua. ■

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Sewerage water...

irrigation, consumers eat up the food containing remnants from Kariobangi jua kali and other neighbouring industries - spray for painting cars, smelting ores and used oils - as well as sewage wastes from households and commercial buildings. Many people cannot detect the contaminated vegetables and fruits as they often look quite attractive on the market stands.

Using polluted water for irrigation not allowed

According to the NEMA regulations, wastewater for use in irrigating crops must be purified before being released into rivers and other water bodies. When used in irrigating fruit trees, irrigation should stop two weeks before fruit is picked and fruit should be picked off the ground. Overhead irrigation should not be used.

Danger of heavy metals contamination

Farmers should know that using polluted water for irrigation especially in this dry season causes their accumulation in the soil. Furthermore, crops grown



using such water absorb the heavy metals that remain concentrated in different parts of the crop. This raises health concerns if the crop is consumed as the metals and harmful bacteria accumulate in the bodies of humans and animals and cause diseases and other adverse health conditions.

To ensure you have clean and safe water for irrigation, harvest and store water during the rainy season. Avoid using waste water or river water that has not been treated. If possible, use tap water to irrigate your crops as this has been treated and is safe for drinking and watering crops and animals. ■

The right amount of compost to use for maize

What is the correct ratio of manure application per hole when planting maize?

An acre of land requires about 2.5 tonnes of manure, which is well-composited (well-composited manure is dark brown in colour, has a sweet smell and a crumbly structure). Manure should be incorporated into the soil as soon as it is ready. Ideally, manure should be fully worked into the soil to ensure it mixes completely. In lighter soils, the manure should be mixed deeper into the soil (up to 20cm). In clay soils, manure can be applied on the surface like mulch, which helps to stimulate the micro-organisms in the soil. Farmers can add some mulching material such as dry grass or plant leaves to prevent loss of nutrients from the manure.



when you apply chemical fertilizer. It therefore takes time before you start seeing good results in terms of yields after manure application. It is always a good farming practice to keep on adding manure every year when preparing the land for planting. After or even before ploughing, spread the manure across the field and then plough. This will ensure the manure is well incorporated into the soil, and reduce nutrient loss.

Build soil fertility gradually

Do not expect to see good results in the first year of manure application. The uptake of nutrients from manure is not as fast as

Compost may not be enough

As for the rate of application of manure for every hole while planting, you can apply one handful to every hole. The effect on the maize will, however, be very minimal since maize is a heavy feeder; therefore we would advise that when using compost for the first time, you can add a bottle top of concentrated organic fertilizer to boost the maize growth because the amount of nutrients in one handful of manure is very little and may not help the maize in meeting its nutritional requirements during the growth phase. This is one reason we would advise you to first build the fertility of your soil by adding compost for several years before you can fully rely on compost for fertilization.

The importance of ash in compost

Why do we use ash during making of compost?

Most of the organic material used in making compost do not have adequate amounts of potassium. Ash has a good amount of potash and that is why it is recommended for incorporation into the compost. You can add ash after every layer of compost to ensure the trace elements in the ash are incorporated into your soil. When added to compost, ash can also help neutralize acidity in the compost as it is more alkaline in nature. It can also help to keep of harmful pests such as snails that may attack the crops you intend to plant. Do not use ash from charcoal as it has some chemicals that may be harmful to your crop if present in high concentrations.



What could be the problems with my chickens?

I have observed the following symptoms on my indigenous chickens. Kindly help:

1. Swelling of young birds' bodies leading to death.

The problem could be ascities: You should avoid using chick pellets for sometime and use chick mash instead. The temperature in the chicken shed could be high. Roll up the curtain to reduce the temperature and change the beddings regularly as there is danger of pathogen build up in the shed, which can lead to disease outbreak.

2. No appetite, no digestion and dullness leading to deaths.

The problem could be indigestion, provide them with clean drinking water mixed with liquid paraffin to loosen their stool.

3. No laying eggs and when slaughtered, I find growths in their ovaries.



If the birds are old and with a laying percentage of less than 45-50% it is advisable to cull (slaughter or sell) them. Such problems do occur with old age.

4. Sticky droppings leading to blockage of outlet hence death.

The problem could be coccidiosis, you can give them anticoccidants (buy this from an agrovet) adminis-

tered through their drinking water and ensure cleanliness of the feeders and waterers.

There could also be a build up of bacteria if the beddings are old and dampy - ensure good hygiene in the chicken house.



Farming Tip

Red or black soil, which is better?



Soil colour is helpful in classification and identification of various characteristics. For example, red soil has the red colour because of the presence of iron oxide. Although red soil is mostly acidic and it tends to lack phosphorus nitrogen and humus, it can be made fertile through addition of farmyard manure. Red soils are also prone to leaching of essential nutrients such as calcium, potassium and magnesium.

Black soil retains the black colour because it is high in organic matter. Black soil is more fertile because of the presence of high organic matter. Organic matter contains most nutrient, which improves its physical structure and enhances plant growth. Most black soils are rich in iron, lime, calcium, potassium and magnesium carbonates.

Farmers should know that both black and red soils are good for agriculture, but what matters most is the way the soil is managed. Too much acidity in red soil is corrected by adding lime while high alkalinity in black soils can be corrected by adding compounds containing sulphur eg. brimstone. Farmers have to do a soil test in order to be able to identify and correct any deficiencies in their soils in order to make them productive depending on the crop they want to grow.



TOFRadio answers your questions

TOFRadio is broadcast on Milele FM at 8:30pm on Tuesday, and KBC on Thursday at 8:15pm. Tune in and listen to farmer experiences and expert advice on agribusiness and eco-friendly farming methods. On this page, we respond to some of the issues raised by farmers in their correspondence to the radio program. Send your questions and comments via SMS 0715 916 136.

Poor quality seeds means low yields for farmers

Musdalafa Lyaga | Kenyans love their maize roasted, boiled, fried or milled to make porridge or their favorite *ugali* meal. In spite of the high demand for the cereal, Kenyan maize small-scale farmers continued to experience poor harvests. This is in spite of interventions by government and others in the sector. Even though there are a number of reasons for low yields, poor quality seed are partly to blame.

Sources of seeds

Farmers rely on their neighbours, community seed banks, Agricultural Research Institutions, local and International NGOs, national seed banks, large seed supply companies, among others for their seeds. Sometimes farmers fail to get the right seed varieties for their climatic conditions.

Know your maize varieties and climatic conditions

Highland Maize Varieties

These varieties are bred and recommended for medium to high altitudes (1500-2100m) where day temperatures seldom exceed 28°C during growing season and where the night temperatures drop to as low as 8°C. Rainfall requirements ranges from 800-1500mm. Examples include H6213, H6212, H6210, H9401, H629, H628, H627, H626, H625, H614, H624, H623, H516, H515, H513, H511, PH4, PH1, DH01, DH02, DH03, DH04, Katumani composite and DLC 1.

Medium Altitude Agro-Ecozone (1000-1700m)

These varieties are commonly grown in coffee growing belts. The favourable rainfall is between 750- 1000mm. Some of the varieties in this category include H513, H515 and H516.

Transitional Zone

The altitude in this zone falls between 1000-1700m where the temperatures ranges from 12°C to 30°C and has rainfall similar to that of high altitudes. Hybrid 624 is a typical example in this category.

Lowland Agro-Ecozone: PH1 and PH4



Seeds are specially developed for specific regions in the country. A lot of laboratory and field tests are carried out to ensure quality.

Pwani hybrids are fairly short varieties resistant to lodging and more tolerant to moisture stress and recommended for altitude range of 0-1250 M above sea level with 400mm of rainfall. It has an added advantage of good husk cover hence reduced crop loss through bird and weevil attack. It is also suitable under inter-cropping systems.

Dryland Agro-Ecozone: Katumani Composite B

This is a fast growing open pollinated variety, which is fairly short and produces short cobs. It is a drought resistant variety flowering within 60-65 days and maturing within 90-120 days.

The variety performs well within altitudinal range of 1000-500M above sea level and is a variety for marginal rainfall areas. The variety requires 250-500mm of rain, and has performed extremely well in arid marginal areas in many parts of Africa particularly in Somalia, Ethiopia, Sudan, Tanzania and



Namibia.

Dryland Agro-Ecozone (DLC1)

This is another open pollinated variety, which is recommended for arid and semi-arid regions. This variety flowers earlier than Katumani Composite B by about 4-7 days and is shorter but more prolific. Under unfavourable conditions the variety performs better than Katumani Composite B. The variety is best suited where rainfall duration is short and amounts to less than 350mm. The variety is a good substitute for Katumani where rainfall is unreliable.

How to produce own maize seed

As a way of coping with drought conditions and climate change, many smallholder farmers are now continuously developing improved seed selection practices and other on-farm breeding strategies.

Farmers' own maize seed can only be produced from varieties which are not hybrids. Hybrid varieties are made by planting two varieties in the same field, allowing only the male parent to produce pollen, and harvesting the seed only from the female parent. This is controlled crossing of two different parents.

The offspring (the hybrid) will perform better than the average of the parents or even better than each of the parents. Generally hybrid maize, varieties are denoted by letter "H".

farmers forum

0717 551 129 / 0738 390 715

Beehives for sale: We make beehives for sale. Interested farmers can make orders on any quantity they require. The following are prices for various hives: Langstroth Ksh 4,500, Kenya Top Bar Hive Ksh 3,800, Stingless bee hives between Ksh 400 and Ksh 1,500 depending on size. Interested farmers can call Stephen on 0734 371 557.

Grafted avocado seedlings: We have grafted avocado seedlings, selling at Ksh 70 per seedling. We can supply any quantity. Call 0716 795 253, Nairobi and Muranga.

Silage tubes for sale: We have silage tubes for sale. We also conduct training for farmers groups. Call Star Rays Education Centre Tel. 0721 245 443.

KARI improved kienyeji chickens for sale: Day old, 1 week, 3 weeks and 1 month. Call 0725 681 110, email: antonville@outlook.com

Seedlings: Eucalyptus at Ksh 10, grevillea at Ksh 10, Mwangi at Ksh 10, Calliandra at Ksh 10, pine at Ksh 10, Leucaena at Ksh 15, Muu at Ksh 15, Meru Oak at Ksh 15 and ornamentals at Ksh 15. Contact 0751 915 068

Some examples of hybrid maize varieties in Kenya include: "H 614", "H 626", "KH 600-15A", "H 516", "KH 500-21A", "Pwani Hybrid 1" and "Pwani Hybrid 4". But if you try to plant the seeds from the cobs of these hybrids, your plants will not have the characteristics of the mother plants and also the yields would be different.

Non-hybrid (open pollinated) varieties are produced by allowing maize plants to pollinate freely, and seed can be harvested from all healthy plants. Some examples of open pollinated maize varieties in Kenya: "Coast Composite", "Katumani Composite B", "DLC1", "Kikuyu" (a landrace which is popular in the Central Province of Kenya). A landrace is a variety developed by farmers under influence of their farming system and their physical environment (soils and weather). Landraces are characterised by high genetic variation (or differences).

(Source: Kenya Seed Company)

For more information on maize seed selection, please visit www.infonet-biovision.org