



Officials from Access Agriculture Organisation Mr. Francis Chepyegon the ICT Officer (Left), Ms Beatrice Mueni, Partnership Development Officer (Second left) and Ms Nafissath Foussemi Barres, Monitoring and Evaluation Manager (third left) hand over video production equipment worth Ksh 420,000 to Biovision Africa Trust (BvAT) Farmer Communication Programme team led by Musdalafa Lyaga, TOFRadio Assistant Producer (3rd from right) Hudson Shiraku, the BvAT Programme officer (Second from right) and Njeri Kinuthia, BvAT Outreach officer (right). The organization has been collaborating with Biovision Africa Trust (BvAT) in the dissemination of information to farmers in Kenya. Access Agriculture works in several African countries where they produce training videos for farmers.

Dear farmers,

In the past issues of *TOF*, we have warned farmers against rushing to buy items they see in newspaper advertisements and other media before first confirming the integrity of the people or companies selling the products or services. Some of the products in the market are not genuine, which may cause huge losses to those who buy them.

In the last few months, the local media featured a Kenyan company that was offering farmers pure Holstein-Friesian cows allegedly from South Africa on very good credit terms. All a farmer was expected to do was to make a down payment after which the company would finance the balance. The farmer would be allowed to pay the balance in convenient monthly instalments over a specified period from milk sales after getting the dairy cows.

Many farmers trooped the company offices in Nairobi to make the down payments and sign contracts with the company without making the necessary background checks. Some even took loans to settle the down payments.

The company even contracted a number of companies to start making zero-grazing sheds for the farmers in their waiting list. When it took too long for the animals to be delivered, farmers started making enquiries at the company offices with others demanding to have their money back. The directors have since disappeared, with millions of farmers' money and debts owed to contractors.

Kenyan farmers should learn from experience. Only a few years ago many farmers lost millions in a scam, when crafty traders spread word that quail business was the next big money spinner for farmers. Farmers have also been targets of fake companies and individuals selling substandard fertilizers, pesticides and even seeds. It is always important to countercheck the authenticity of any product or service being sold in the market. Always buy your products from reputable companies or individuals you know well.

Kenyan farmers should also know that there are high quality dairy cows sold in various breeding farms in the country. Breeds developed locally are usually better than imported ones as the local ones are adapted to local conditions, can resist diseases, have consistent milk supply, among other advantages. *Page 4*

Potato seed poses danger of PCN spread

TOF - In last month's issue of *TOF* (*TOF* No.131, April 2016), we reported the spread of the Potato Cyst Nematode (PCN) in all parts of the country. Farmers are advised against buying potato seed material from other potato growers or seed producers to reduce the risk of introducing the pest

into their farms. Our investigations reveal that many potato seed growers including government institutions such as KALRO are still selling seed, which is highly likely to be infested with the pest.

The sale of potato seed is going on despite the fact that Kenya Plant Health Inspectorate Service (KEPHIS) and independent research scientists have established the existence of the pest at the KALRO Tigoni National Potato Centre including all its seed multiplication farms at ADC Molo, Marindas and Njabini Agricultural Training Centre (ATC) and even in farms owned by independent seed potato producers.

In a communication sent to the KALRO Head of Commercial Enterprises Dr Lawrence M'Ragwa on 29 April 2016, the KALRO Tigoni Centre director Margaret Muchui requested the KALRO Headquarters to help the centre to sell 289, 50kg bags of *Tigoni*, *Kenya Karibu* and *Sherehekea* varieties of basic seed to seed producers and farmers for multiplication. The sale of any seed infested with the PCN pest poses the



risk of spreading the pest to new areas in the country. The Kenyan government is yet to declare the presence of the pest to the FAO International Plant Protect Convention (FAO/IPPC) to enable its listing among countries affected by the pest.

The PCN pest (*Globodera rostochiensis*) is classified as a quarantine pest. It was discovered in Nyandarua district in September 2014 but so far the government has not taken any measures to stop its spread. It is a devastating pest that can wipe between 80 to 100 per cent of a potato crop. It can remain in the soil for a period of up to 30 years. Currently there is no chemical or biological method that can control it.

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Protect crops against pests and diseases naturally

Chemicals are easy to use as protection against pests and diseases but they cause great harm to humans, animals, beneficial organisms and the environment. Natural crop protection methods are safer and cheaper for farmers.

Joyce Wambui Mahui | As the pressure of pests and diseases continue to mount at this time of the year, many farmers are looking out for quick solutions with most of them rushing to shops for quick fixes which result in heavy use of harmful synthetic chemicals. What many farmers are oblivious about is the long term effect of heavy use of synthetic chemicals to their health, livestock, crops and the environment.

Chemical pesticides intended for pest control are often toxic, and therefore hazardous to humans, animals, other organisms and the environment. Health effects of pesticides may be acute or delayed to those who are exposed.

Research has established that acute health problems may occur in workers that handle pesticides, such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems.

Synthetic chemical pesticides harmful to humans

The long term effects may include leukemia, lymphoma, brain, kidney, breast, prostate, pancreas, liver, lung and skin cancers.

Strong evidence links pesti-



Farmers scouting for pests.

cide exposure to birth defects, foetal death and altered foetal growth. Pesticide exposure may result in reduced fertility in males, genetic alterations in sperm, a reduced number of sperm and altered hormone function.

Dangerous to livestock

Livestock can be affected by pesticides due to their high toxicity. The harmful compounds are absorbed through the skin, lungs, eyes, and from the digestive tract. In livestock, exposure to chemicals may cause inflammation of the digestive tract causing diarrhoea, abdominal pain, thirst, weaknesses, respiratory failures, among others.

They kill beneficial insects

The chemicals also kill beneficial insects like bees which are very crucial in pollination. In bees, which not only give us honey but are the major pollinators, chemicals have been known to wipe out bee populations with disastrous effects to agricultural production. Other beneficial insects which have been victim to chemical use include parasitic wasps and lady birds that control natural harmful pests such as thrips, worms and caterpillars naturally.

Farmers have better alternatives which are natural and safe. The following are some of the organic products that control pests in an environmentally friendly way:

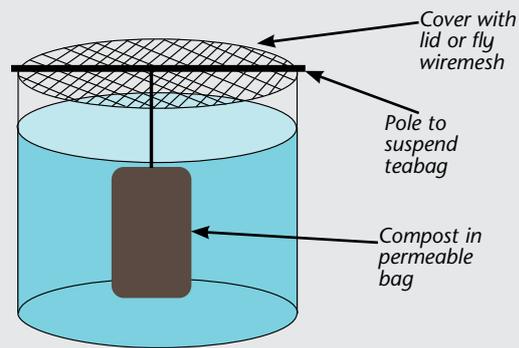
Diatomite

Tiny microscopic organisms that pierce and kill pests on contact. They target pests such as weevils, aphids and mites. Diatomite also contains micronutrients such as calcium, phosphorous and magnesium. It is available at the African Diatomite Industries (ADL) in Gilgil.

Thuricide HP®

This is a bio-pesticide that controls nematodes such as leaf-chewing larvae of lepidopteran insects. It does not harm ben-

How to make liquid fertilizer or compost tea



Plant extracts can be mixed with liquid manures to protect crops.

eficial insects. It is available at Farmchem Ltd.

Clean start®

It is a fungicide that is also used as a root guard, phosguard, humus and natural wet. The fungicide controls fusarium, scietoria, rhizoctonia, pithium among diseases.

It is good for tomatoes, potatoes, cabbages, capsicums, passion fruits, avocados among others. It is available at Juanco SPS Ltd.

Pyegar®

This is a plant extract-based product that repels and controls most insect pests. It is non-toxic to mammals, bees, fish and other micro-organisms. It is available at Juanco SPS Ltd.

Nimbecidine®

This is neem extract biopesticide that controls nematodes, mites and other pests. It does not harm beneficial pests and is available at Osho chemicals Ltd.

GC-3®

It is a garlic extract with properties that control powdery mildew and 11 other species of fungi. It has no serious toxicity effect and is available at Juanco SPS Ltd.

Rootguard®

This is a fungicide and pesticide that controls most fungal diseases such as botrytis and pests like caterpillars, diamondback moth, among others. It is avail-

able at Juanco SPS Ltd.

Fosphite®

It is used as both fungicide and fertilizer. It contains potassium salts and phosphorous which control mildews, leaf spot, blights, fusarium, damping off, rootrot and rust.

Fosphite has a long lasting effect for about 28 days. It should not be mixed with copper-based fungicides. It is important to allow 20 days before applying it to copper treated crops. It is available at Juanco SPS Ltd.

Pyneem 20EC®

This is a biological pesticide that contains pyrethrins and neem oil among other inert ingredients. It controls most pests during the growth phase of affected crops. It is safe for mammals and soil micro-organisms. It is available at Juanco SPS Ltd.

PL Plus®

This is a biological nematicide that contains *Parcolemus lilacinous* which kills nematode eggs and young nematodes. The compound lasts long in the soil. It is available at Juanco SPS Ltd.

Farmers can contact these companies through telephone contacts shown below:

- Juanco SPS 020 2088 793.
- Osho Chemicals 254 20 3912000
- Farmchem Ltd 020 55271 or 020 550 448.
- African Diatomite Industries 0722 277 120

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 nor Biovision Foundation.

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Publisher icipe-African Insect Science for Food and Health, P.O. Box 30772, 00100 Nairobi, KENYA, +254 20 863 20 00; icipe@icipe.org; www.icipe.org
Editors Caroline Kinyulusi, Peter Kamau
Administrator Lucy W. Macharia, 020 863 21 86
Editorial Advisory Board Dr. Sunday Ekesi (ICIPE), Dr. Nguya Maniania (ICIPE), Dr. Joseph Mure-

ithi (KALRO), Dr. Henry Kiara (ILRI), Dr. David Amudavi (BvAT), George Nyamu (KENAFF), John Njoroge (KIOF), William Makechi (farmer, Likuyani), Regina Muthama (farmer, Machakos) and Rt Snr Chief Josiah Arende (farmer, Rongo).

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Sponsor Biovision, a Swiss-based foundation for the promotion of ecological development, based in Zürich, Switzerland.
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Discover the true value of finger millet in your diet

Finger millet is an orphan crop because very few farmers grow it nowadays. But the crop is packed with many health benefits that can prevent many nutritional problems and diseases associated with modern foods and lifestyles.

Josephat Mulindo | If there is one crop that is undervalued and has not received the recognition it deserves in modern farming, it is finger millet. Consumed for centuries, finger millet is a neglected crop that was valued by our ancestors. It is one of the few crops with exceptional nutritional benefits. It is, however, missing in most people's diets today and has been replaced with tea, bread, sausages and eggs.

Finger millet belongs to a category of nine crops collectively called "millet". Only four types of millets are produced in Africa and one of them is finger millet. The finger millet grain is gluten-free and is packed with vitamins and minerals. A gluten-free diet is primarily used to treat ailments such as celiac disease. Gluten is found in grains like wheat, barley, rye and malt.

Nutrient composition: Finger millet is full of nutrients and other values needed by the body. These include:

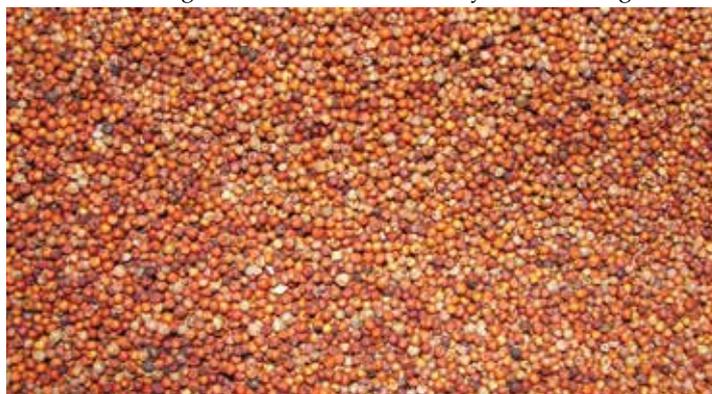
- **Magnesium** - helps reduce migraines, asthma, high blood pressure and heart attacks.
- **Calcium and potassium** - Of all the cereals and millets, finger millet has the highest amount of calcium (344mg per 100g) and potassium (408mg per 100g). Calcium is useful in building and maintaining strong bones, heart, muscles and nerves. Potassium is useful in preventing stroke, heart and kidney disorders, anxiety and stress; controlling blood pressure; as well as enhanced muscle strength, metabolism, water balance, electrolytic functions, and nervous system.
- **Niacin** (vitamin B3), helps lower cholesterol.
- **Phosphorus** helps with fat metabolism, body tissue repair and creating energy in the body.
- **Fibre** protects the body against breast cancer and other illnesses.



Photo: IN

- **Phytochemicals** like phytic acid lowers cholesterol, while phytate, is associated with reduced cancer.
- **Proteins:** contains essential amino acids, which are building blocks of proteins. These include eleusine, tryptophan, cystine, methionine (these are absent in most cereals including wheat, rice and maize), phenylalanine and tyrosine.

These nutritive values make finger millet important in everyone's diet and more so, children, those recovering from illness and pregnant and breastfeeding women. It is used in the management of measles, anaemia, and diabetes. Finger millet is useful in the manufacture of food formulations and breakfast cereals for babies and people recovering from illness. Its flour can be mixed with flours from cassava, soya beans, orange-fleshed sweet potatoes and wheat flour to make bread and other baked products. Finger millet has good malting qualities too (second only to barley) and has great potential in brewing local brews like *busaa* and lager beers.



Growing: Finger millet is an ideal crop in dry areas because it can lie dormant for weeks. Once the rains come, the grain springs to life and can be ready to harvest in just forty-five days. The crop thrives in an environment with medium rainfall, an annual temperature range of 15 to 30°C and a soil pH of 5.0 to 8.2. During seed ripening and maturation low amounts of rainfall and low relative humidity.

When grown, finger millet can be intercropped with cereals like sorghum, legumes and oil crops like groundnuts, cowpeas, pigeon peas and sesame, and root crops such as cassava. Finger millet is traditionally broadcast but row planting has been promoted to realize higher yields and for ease of weeding. The finger millet provides farmers with the best available opportunity for reliable harvest especially in an environment with erratic, scanty rainfall, and low soil fertility levels.

Processing and use: Finger millet is usually processed using traditional methods. Harvesting of mature panicles (grain head) is mostly done using thumb

knives. After harvesting the millet is dried well and then milling is done before finger millet products are produced for use. Because of lack of information, the finger millet use is generally limited to porridge, ugali and opaque beer (*busaa*). There are, however, other food and feed products that are made from finger millet.

Commercialization: The finger millet grain is resistant to rot and insects and keeps well in storage, making it an important staple and income earner. If kept dry, it can store for as long as five years. Some farmers in Western Kenya have stored the crop still in their panicles for the last 5 years without chemical treatment. Besides longer storage, the price of finger millet is not as volatile as that of other cereals. It is generally double the price of maize and sorghum. ■

Other benefits of finger millet

Millet should be part of daily diet because:

- It does not feed toxic yeast (or candida) and therefore is safe.
- It acts as a prebiotic, feeding important microorganisms in the body like bacteria.
- It provides serotonin, which helps in calming and sooth moods.
- It helps in colon hydration to keep it in the best state.
- It is alkaline and digests easily without burdening the digestive system.

Breeding: An important step in dairy farming

When a farmer does not know which bull served their cow, there are high chances of the farmer serving the cow's daughter with the semen from the father. This is called inbreeding.

Peter Kamau | Breeding is an important aspect of modern dairy farming anywhere in the world. However, small-scale farmers lack even the most basic skills in dairy cow breeding which is a big problem to the development of the livestock industry in the country. Selection of the right animals to breed is crucial for any profitable dairy farming enterprise. Before inseminating their cows, farmers should at all times know which bulls have desirable qualities so that they can pass the characteristics into their dairy or beef cows.

More than 3.3 million (99% of dairy farmers) in the country use Artificial Insemination (AI) services. Unfortunately, most farmers do not know how to select semen from high quality bulls. They do not keep records to show which bulls were used to serve their dairy cows. When a farmer does not know which bull served a particular cow, there are chances of the farmer serving the cow's daughter with the semen from the father, which would cause inbreeding. Inbreeding is the process of mating closely related animals and should be discouraged..

Research shows that less than 5 percent of farmers in Kenya keep their dairy cow records. This means that 95 per cent of dairy farmers do not keep any records that could help them avoid inbreeding and upgrade their dairy cows to their full potential in milk production. Research also shows that 75 per cent of farmers in the country are exposed to inbreeding due to lack of proper animal records.

What is inbreeding?

To understand what is meant by inbreeding, let us revisit the relationship between animals and how inbreeding affects their health and productivity.

All animals carry genes that determine certain characteristic such as the height of the animal, colour, shape, milk yield and fertility. Although all cattle have good genes, some have bad genes that remain hidden if their young ones are born of

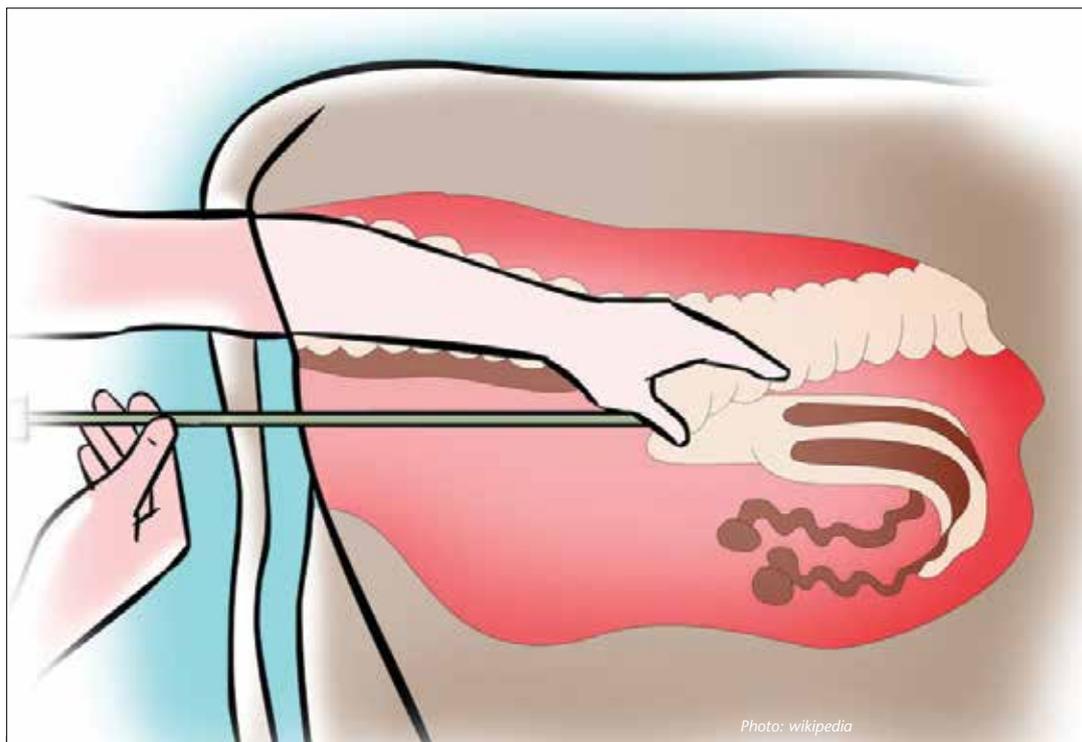


Photo: wikipedia

A sketch showing the right way to artificially inseminate a cow.

parents which are not related. Animals from the same family carry the same genes or traits including bad ones - when such animals are mated, the young ones of these animals will inherit these bad genes or traits from both parents.

Such animals often develop many problems including complications that lead to still births (giving birth to dead calves) stunted calves, poor fertility, frequent diseases and even deformities.

In order to avoid such traits, scientists recommend that animals sharing great grandparents, grandparents or parents should not be mated. This means that family records of the bulls and cows should be checked before any mating is done so as to make the correct choices of bulls and cows.

Why is inbreeding common in Kenya's AI services?

Before 1990s, the Kenya National Insemination Service, now renamed Kenya Animal Genetic Resource Centre (KAGRC) managed to control inbreeding through a number of measures:

1. Bull semen was rotated between regions after every 2 years.
2. All farmers using AI services were issued with a red file which had the cow index cards; each cow's index or identification number was made to give it a unique

identity. The AI service agent had to carry a minimum of two bulls' semen of the same breed - he would check on breeding information in the file before carrying out an insemination to avoid serving the target animal with semen from a related bull.

3. AI officers maintained farm records with details of each cow for supervision and even follow-ups.
4. Periodically, a team of veterinary officers from vet-

erinary headquarters would also make follow-up visits on selected farms to ensure the system was observed.

Nowadays, most dairy farmers do not keep any records. They only have mental records of milk production and cow-offspring relationships. Some farmers with records do not have any entries in them while many others cannot show even the most recent insemination records or could not remember where they kept them. ■

What farmers can do to avoid inbreeding

The following are simple rules or measures that farmers can take to upgrade their animals to improve productivity of their dairy herds and reduce the danger of inbreeding:

- Always maintain records of each animal such as date of birth, AI records such as the name of the bull that sired it (whose semen was used to serve your cow), date and age at service, number of times that the animal has been inseminated, calvings and serving intervals.
- Avoid using village or neighbours' bulls to serve your cow to stop transmission of venereal diseases or even brucellosis. If you have bulls, separate them from the cows at all times to avoid inbreeding.
- Try and register all your animals with the Kenya Stud Book (KSB). An animal registered with KSB fetches a higher price in the market than those that are not registered.
- Do not throw away the semen straw when your cow is served through AI service for future reference. All straws are labelled with the name of the bull to avoid serving the daughter with the same bull (this causes inbreeding).
- Always use semen from high quality bulls whose potential or characteristics are known.
- Always use semen from known service providers recognized by KAGRC to upgrade your cows, improve their milk production, health and speed up their growth rate.

Protect your bean crop against bean fly damage

The bean fly pest can destroy an entire bean crop, scientists at ICIPE have discovered a fungus which when combined with other cultural control methods can help reduce the pest and enable farmers to increase their bean yields.

Berita Mutane | Have you ever noticed stunted growth, yellowing of leaves and drying up of your bean crop? The culprit could be the bean fly or Bean Stem Maggot (BSM, *Ophiomyia* spp, Diptera agromyzidae). Bean flies are among the most destructive pests that affect beans and related crops including cowpeas, soybean and even mung bean. The adult fly is about 2mm long with clear wings that reflect a metallic blue colour when placed in sunlight. The wings of bean fly do not fold but form a V-shape when the fly is resting.

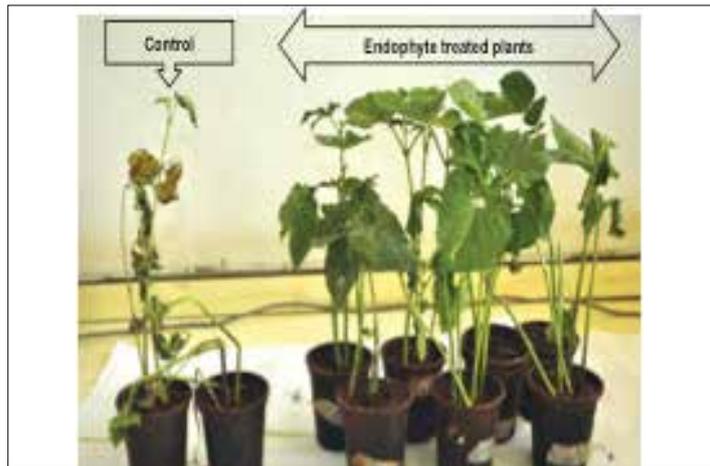
The bean fly deposits its eggs directly on the stem, leaf or emerging bean. The incubation period is 2-4 days, after which the larva, a small white maggot eats its way into the root zone where its pupa develops. The larva may travel through the leaves, and eat its way into the stem down to the root collar. During its movement, the larva feeds extensively into the stem tissue to form a pupa within 10 days.

Affects seedlings

Bean flies become active during the rainy season like now when there are heavy rains in many parts of the country or dry spells. They can occur more frequently where drip irrigation is used. Bean fly can cause up to 100% seedling loss in some varieties of beans when the infestation is high. The bean fly feeding activity destroys stem tissue and reduces root formation. Some plants try to form new roots above the damaged areas. Young bean plants of infested plants under the stress start wilting and die within a short time. Older and more vigorous plants may tolerate the damage but the overall growth and bean yields are affected

Symptoms of bean fly infestation

The Bean fly infestation occurs in Kenya in mid to high altitude regions such as Taita, Embu



The beans on the right have been treated with endophytic fungi. Untreated beans (left).

and Mount Kenya. Bean flies oviposit (lay eggs) on young seedlings and larval feeding and tunneling (making holes in bean stems) which interferes with nutrient uptake and creates avenues for entry of disease organisms. Moreover, the presence of bean fly pupae in the plant results in swelling, stem rotting and premature leaf fall which can result to 100% yield losses. Bean yields among small-scale farmers in Kenya is low.

Prevention measures

Generally, bean fly management is mostly dependent on pesti-



A bean fly



A bean fly larva



Bean fly pupae

cides which are applied as seed dressing or foliar sprays. Cultural control methods such as timely planting dates at the onset of rains before the pest builds up later in the season, intercropping beans with leeks can help to repel the pest, appropriate plant spacing, mulching with straw, earthing up soil in ridges around the base of the plant, crop rotation which allows the field to take a break, biological control using natural enemies and use of resistant varieties. Published reports indicate that some of these control options are faced by a number of challenges that includes; human and environmental concerns, development of pesticides resistance, prey/ predator ratio amongst others. Therefore, there is a need for improving or adopting other eco-friendly alternatives in controlling bean flies by increasing systemic resistance of beans using fungus that colonizes plants.

ICIPE scientists discover solution

Researchers at ICIPE have come up with alternative strategies that are safe, environmentally friendly, and cost-effective through the use of fungal endophytes and entomopathogenic fungi (EPF). This fungus can be applied through seed dressing before planting. In their paper "Fungal endophytes as promising tools for the management of bean stem maggot *Ophiomyia phaseoli* on beans *Phaseolus vulgaris*. *Journal of Pest Science*, DOI 10.1007/s10340-015-0725-4", the authors have demonstrated that fungal endophytes can be considered as the first line of defense strategy against the bean fly. Entomopathogenic fungus has the ability to enter and colonize

plant tissues and improve plants immunity against attack by bean flies and the selection of a suitable fungus type is the first line of treatment.

Fungus reduces damage

Results have shown that fungal endophytes have the ability to colonize the bean plant parts and to confer them with protection against the bean fly. *Metarhizium anisopliae* ICIPE 20 outperformed all the other fungal isolates in negatively interfering with bean fly life cycle. The number of feeding punctures was seven times lower in plants treated with ICIPE 20 as compared to the plants without the fungus treatment. Plants treated with ICIPE 20 recorded the lowest number of pupae which resulted to 89% reduction as compared to those that were not treated with the fungus.

In addition, *Metarhizium anisopliae* isolates, ICIPE 20 and ICIPE 30 had significantly lower numbers of adult emergence which implies a reduction in adult population and a subsequent effect on the next generation. These outcomes suggest the possibility of utilizing fungal endophytes as tools for the management of bean fly in East Africa. Due to potential for adaptation, future studies should focus on broad negative endophytic properties, mode of action, their traceability within plant tissue and their performance under field conditions.

Other cultural control measures

Farmers can also take the following measures to control the bean fly:

- If the infestation is high, spray the young bean plants with a biopesticide (eg neem-based pesticides Nimbecidine®pyrethrum, sodoms apple etc).
- Earth up the soil around the already affected stems allowing the bean plant to develop new roots.
- Avoid over watering especially when using drip irrigation method.
- Add neem cake or Pymark® (pyrethrum cake) to planting holes and later around the root zone of the bean plants.
- Mulch young bean plants.
- Be vigilant and deal with problem before it becomes a disaster.

Potato farmer develops profitable crisps business

Francis Njoroge has through trial and error managed to turn a small crisp startup into a full time business and reliable source of income.

Peter Kamau | Four years ago, Francis Njoroge quit his job as a matatu driver and went into potato production in Ndaraja Mbili village in Murungaru, Nyandarua County. But he soon realized that potato production was not a profitable business due to fluctuating prices and exploitation by brokers.

Denied information by crisp factory

One day, he entered one of the supermarkets in Nairobi. On one of the shelves was a whole range of potato crisps from different companies: "I got an idea of making potato crisps. I immediately bought a packet of crisps and read the label where I found that the manufacturing company was located along Lunga Lunga road, industrial area. I immediately took a matatu to industrial area to find out more about the crisp making business. At the factory gate I explained my mission to the security people who passed my message to the factory management. Their answer was no. They could not allow strangers into the factory," he says.

Experimented at home

Njoroge did not give up. He bought some deep frying oil and went home where he chopped some potatoes and deep fried them in a *sufuria* (cooking pot) to make crisps. When they were ready, he tasted them and discovered they were as good as those he bought from the supermarket. He gave some to his wife who confirmed the crisps were just as good. To make the crisps even tastier, Njoroge sourced some spices composed of onions and cheese which he had read on the package from the supermarket. The spices brought the crisps to the same standard as the ones from the supermarket. Now he was prepared for the crisp making business.

Uses *jua kali* machinery

Since he wanted to make crisps as a business he went to Karibangi Industries in Nairobi where he requested to know if the *jua kali* artisans could make a potato peeler and crisp

chopping machines. The artisans agreed and within a short time the machines were ready.

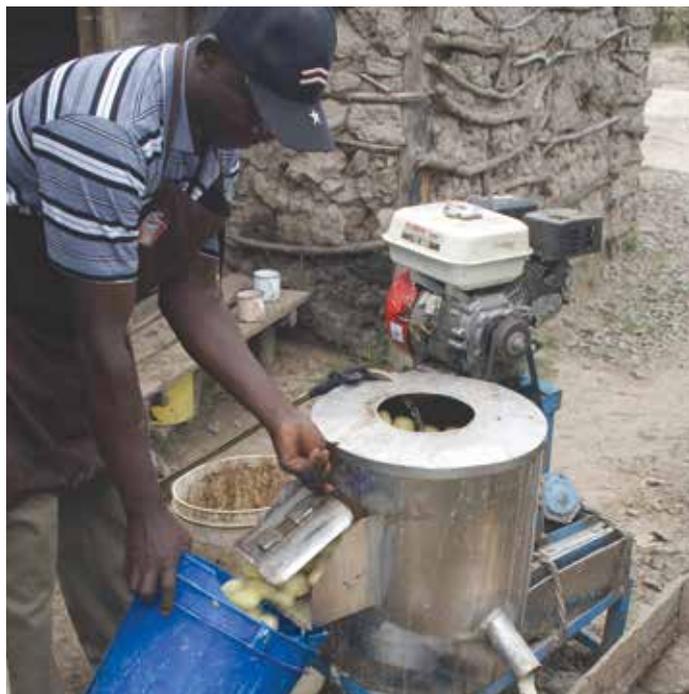
Increased demand for crisps

Njoroge started by buying 2 debes (about 50kg) of potatoes per day from which he would make 80 packets of 50g each that he would sell for Ksh15 a packet mainly to kiosks, retail shops and canteens in schools around his home area. He soon received orders from more kiosks and retail shops. He has since increased his daily production of crisps which has forced him to buy at least two bags of potatoes every day, and the demand is increasing.

Source of income

From crisps sales, Njoroge makes a profit of Ksh 1000 every day. He says he is now able to pay fees for his two children who are in secondary school. He has managed to buy 3 dairy cows and plans to buy a plot where he can put up a crisp making factory. His main challenge, however, is getting enough capital to start the factory. He says he has approached a number of financial institutions but cannot meet their conditions to qualify for credit.

Another problem is getting the right variety of potatoes. He uses *shangi* variety as it cooks fast and does not use a lot of deep frying oil. Potato production has gone down in Nyandarua and he is forced to get his supplies from as far as Ndundori and Mau Narok. He buys potatoes for between Ksh 3000 to Ksh 3500 a bag.



To reduce labour through manual Njoroge uses a potato peeling machine



A fabricated machine is used for chopping the potatoes



The chopped potatoes are thoroughly cleaned before deep frying



After deep frying the crisps are ready for packaging and marketing

Factors that affect crops' absorption of nutrients

What can I do to ensure that my soil has the necessary nutrients for healthy crop production?

It is extremely important that crops have all the nutrients they need to grow well. There are, however, many reasons that plants can or cannot absorb nutrients contained in the soil in which they are growing.

Soil composition

Soils high in clay particles will absorb (bind to their surface) more nutrients, while fertilizer will leach (wash through) faster in sandy soil. Organic matter in the soil increases its nutrient-holding capacity and contributes nutrients upon its breakdown.

Soil microorganisms

Some fungi and bacteria may 'tie up' nutrients while others convert the fertilizer to a form that the plant can take up. Some microorganisms are involved in mutually beneficial (symbiotic) relationships with plants. Rhizobium bacteria grow within the roots of some plants. They convert nitrogen from the air into a usable form for the plant while obtaining nutrition from the host plant.

Soil pH

Extremes in pH affect availability of plant nutrients and the concentration of plant-toxic minerals. At low pH levels, calcium, phosphorus, and magnesium become unavailable and manganese can be concentrated to toxic levels. At high pH values, phosphorus, iron, copper, zinc, boron, and manganese become unavailable.

Nutrient availability

Nutrients may be present in the soil but may first require conversion to an 'available' form that the plant is capable of taking up and using. Conversion to an available form is affected by soil microorganisms, pH, soil moisture and chemical reactions. If chemical fertilizers have been used for a long time without the farmers doing soil tests, some nutrients may remain locked up in the soil. Nutrient imbalance occurs when one nutrient interferes with the uptake of the other. For example, too much magnesium in the soil can block the availability of potassium while the presence of more potassium can block the release of magnesium to the plants. In the same way, that excess nitro-



gen can block the availability of potassium and copper to the plants.

Soil moisture content

Most nutrients are taken up via the soil solution, so soil water is needed to dissolve them. Thus, if water is not available in adequate quantities, uptake of the nutrients can be blocked.

Soil aeration

Oxygen is needed in the soil to help roots with take up nutrients. Where there is no oxygen, such as in flooded sites, sugar cannot be utilized by the plants to produce energy for nutrient uptake. Decomposed organic matter helps develop good air-water relationships in the soil.

Soil temperature

Nutrient uptake is faster in warmer soils than in cold soils.

Plant condition

Plants under stress will be less able to take up nutrients, generally due to a reduced or damaged root system.

Competition

If the roots of many plants occupy an area, a reduced amount of nutrients will be available for each. When using close spacing for vegetable maize or beans, more fertilizer will be needed in a bed than in a conventionally spaced row garden. Weeds can also take up nutrients intended for crop plants. Reduction of weeds will reduce fertilizer needs.

Since farmers may not be able to tell what is lacking in the soil unless they do soil tests. The best way is to ensure that their soils have adequate organic matter at all times and when combined with other good organic farming practices, restore soil nutrient balance and regulate the func-



tions of each nutrient. The most important practices that farmers can apply to maintain soil fertility are given below:

Crop rotation: Different crops take different nutrients from the soil. This means that if different crops are planted in same parcel or *shamba*, nutrients taken away by the previous crop are replaced by the new crop and even more nutrients are added. At the same time some leguminous crops such as beans, soybeans, cowpeas, jackbean, groundnuts and peas help to trap nitrogen from the air and fix it into the soil. Farmers who rotate crops every year help to add nutrients. Another huge benefit is the reduction of pests - some pests prefer certain crops if these crops are not planted every year, the pest population reduces. Also, diseases that affect certain crops are also kept in check. For example, potatoes and all other plants in the potato family are affected by bacterial wilt. A farmer practicing crop rotation can reduce bacterial wilt and related pests through this method. Crop rotation has been found to reduce the severity of Maize Lethal Necrosis (MLN) disease (TOF No. 121 June 2015).

Intercropping: Intercropping is the planting of different crop on the same piece of land. For example, if maize is intercropped with beans, the beans provide extra nitrogen that promotes the growth of maize. In areas affected by diseases such as bacterial wilt. Intercropping tomatoes with onions protects the tomatoes from pests such as aphids and white flies.

Farming Tip

Good crop management increases your yields

For organic farmers who do not use chemical fertilizers, pesticides, fungicides and related products that control various threats to crops the chemical way, it is another season of hard work. But this will pay off when they harvest healthy crops that do not contain chemical residues that pose great harm to your health, your animals and the environment.

Since plant extracts and natural foliar feeds do not work in the same way as chemicals, the farmer must ensure that they prepare enough to be able



to apply them at least three times in a week. Due to heavy rains being experienced across the country, much of the fertilizer that was applied at planting has already been washed away or leached. It is easy to tell a crop that is deficient of nutrient because they change colour, sometimes a yellowish colour is

a sign that the crop is lacking nitrogen. Pinkish colour may be caused by phosphorous or magnesium deficiency. Walk through the *shamba* in the morning and afternoon and carefully observe your crops, remove suckers unwanted weeds, examine if there is any pest that is likely to destroy the crop, check the undersides of the leaves for some of the pests that prefer to hide there. Look for any abnormal sign of disease or pests and take action immediately. This way your crops will grow without any problems that cause yield loss.

TOF Radio answers your questions

TOFRadio is broadcast on KBC on Thursday at 8:45pm and Mbaitu FM on Friday at 8.30pm. 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.

Mucuna: A fodder crop that restores soil fertility

Mucuna is an inexpensive source of organic fertilizer that builds up organic matter and fixes nitrogen into the soil. It is also a good source of fodder for the animals and a suitable cover crop that suppresses weeds when planted in a maize field.

Musdalafa Lyaga | Despite the fact that Kenya has a large portion of arable land, many years of heavy chemical fertilizer use and other poor farming practices have made soils poor (for example, with low fertility levels, too acidic or alkaline and with poor texture and structure) leading to very low yields. Currently, the condition of Kenyan soils is of such low quality that some farmers are harvesting as a low as five bags of maize in an acre in places where they used to harvest 30 bags in previous years.

Many factors have contributed to poor soils in the farming areas. These include over-exploitation of land resources. Also, high population density especially in the rural areas, has reduced the quality and size of farming land. Farming families are often forced to subdivide their increasingly small pieces of land for their children, which are not productive. In addition, many farmers have little knowledge on how to use improved agricultural technologies like minimum tillage, planting cover crops, crop rotation and using organic materials to improve their soils.

Chemical fertilizers such as the Diammonium Phosphate (DAP), urea and CAN have been overused, and most Kenyan farmers continue using them for lack of knowledge on more ecologically friendly alternatives that are available in their farms. For example, when mucuna is used as green manure, it helps rebuild soil fertility quickly.

A natural fertilizer and herbicide

In solving the soil problem and to bring the acidity down,



farmers are advised to use the velvet bean (*Mucuna pruriens*) to improve the quality of their soils. Velvet bean is an annual climbing vine that grows to 3-18m in length. Its flowers are white to dark purple and hang in long clusters. The plant also produces clusters of pods which contain seeds known as mucuna beans.

1. It fixes nitrogen

Nitrogen is required in large quantities for growing of cereals like maize, but is usually deficient in poor soils. Like cowpeas and beans, mucuna is a legume that fixes nitrogen from the air. It has a deep root and grows fast, which makes it an ideal cover and green manure crop. When grown in farms, major nutrients like nitrogen, phosphorous and potassium content are increased in the soil. However, most of the crop's nitrogen is stored in the leaves and grains. Thus, when legumes are harvested for food or fodder, most of their stored nitrogen is removed from the field. It is therefore better to till it into the soil so that the stored nitrogen can be released and become available to the crops.

2. Mucuna is an organic fertilizer

When mucuna is ploughed into the soil, it decomposes and this releases not just nitrogen but other important elements like carbon. Its creeping vines produce a lot of leaves and grains, which when ploughed into the soil increase the fertility.

3. Suppresses weeds

As mucuna completely covers the soil, it helps to destroy different weeds. It suppresses broad leaved and horrible weeds like striga. In this way, mucuna helps reduce the cost of weeding and contributes to increasing yields.

4. It is fodder for livestock

Mucuna is valuable for fodder and as a feed legume. Vines and foliage can be used as pasture, hay or silage for ruminants (like cows, sheep and goats) while pods and seeds can be ground into a meal and fed to animals. Despite being good as livestock fodder, mucuna can be toxic when eaten by humans.

Intercropping mucuna and maize

Mucuna is grown in between maize rows during the main rainy season. To make it easy to plant the mucuna, start by planting your maize in rows, leaving 80 centimetres between rows and 40 centimetres between plants. Ropes with marked intervals make planting much easier. Drop two maize seeds in each planting hole. To prevent mucuna from suffocating your maize, sow mucuna when your maize is at least 60 days old.

Weed your maize field before sowing mucuna. Sow about 60kg of mucuna seed per hectare to ensure a good soil cover. Drop two mucuna seeds per hill, every 40cm, in between the maize rows. After harvesting



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Vegetables for sale: We have turnips, radish, kales, spinach, amaranthus. Contacts Mrs Veronich Kimotho Tel. 0720664984, Kinangop.

Potato crisps for sale: We sell good and tasty potato crisps. Contact Francis Njuguna Gachagwi, Tel.072544434, Kinangop.

Tree seedlings for sale: We have indigenous and exotic varieties of trees, Contact Mr. Zachary Mwangi on Tel. 0716319097, Kinangop.

Fruit and fruit seedlings: We have tree tomato fruits, pepino melon fruits and their seedlings. Contact Mr. Waweru Ngundo 0728657941, Kinangop

maize, mucuna keeps growing for a while after the end of the rainy season. The thick layer of mucuna mulch gradually decomposes and helps to conserve soil moisture. Depending on the amount of weeds, you can sow your maize directly in the mucuna mulch without ploughing the field.

Where to get the seeds

It can be difficult to get hold of good quality seed – especially for cover crops. You may be able to find seeds from these sources.

Consult experts

Ask extension agents or researchers if they can get seeds for you. Research stations may have a collection of varieties and be willing to sell you some seed.

Seed dealers and farm supply stores

Good seed companies provide only certified seed, which has been treated with fungicide and insecticide to prevent problems in germination and early growth. If the seed stockist does not have any seed in stock, they can get it from other sources.

Wild sources

Many of the legumes could be growing wild in your area, or they may be planted as hedge-rows or wind-breaks. Collect the seed, dry it and store it ready for planting.

Farmer groups

You can organize a group of neighbors to produce seeds for the group members. You may be able to sell any extra seed to other farmers. ■