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IAEA 與 NEA 動態報告

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BENIN FARMERS INOCULATE THEIR LEGUMES TO IMPROVE SOIL FERTILITY AND YIELD

貝南農民培育他們的豆莢以提高土壤肥力和產量

The farmers of Benin constantly struggle with poor soil fertility which requires them to use expensive fertilizers in order to have a good crop yield – fertilizers that they often cannot afford. But now, through work supported by the Joint FAO/IAEA Division, more than 5 000 farmers have been trained to improve their soil fertility by inoculating their legume crops – inoculating them with a dose of bacteria needed to facilitate the process of nitrogen fixation. The Government of Benin supports a laboratory that produces the inoculum locally and makes it

報告摘要(KEY INFORMATION)

1. 透過糧農組織與國際原子能總署聯合部門的訓練，約有 5000 多位貝南(Benin)農民接受了豆類作物的接種培訓，以提高其土壤肥力。
2. 國際原子能總署實驗室的科學家正在研究污染物是如何被不同的海洋生物所吸收，並進入海洋環境和人類的消化系統。
3. 國際原子能總署發布一個應用程式可幫助海關人員確認在邊境口岸發出的輻射警報是否由天然放射性物質引發，並進一步檢查。
4. 國際原子能總署啟動了一個計劃，期望未來各國能夠在低成本可攜式工具的幫助下迅速發現食品欺詐和污染。
5. 哥斯大黎加在糧農組織與國際原子能總署的支持下，使用黃蜂當作生物防治劑在對環境無害的前提下達到飛蠅防治的效果。
6. 日本經濟產業工商行政管理部長 Yosuke Takagi 先生會見了核能署副局長 Daniel Iracane 博士，討論世界各地核設施除役活動和全球除役趨勢。
7. 來自 31 個國家約 100 多名專家參加了核能署舉辦的非核子廢棄物管理研討會，該會討論了非核子放射性廢棄物的管理和運作以及不同國家的作法。

available to farmers. Since this concept was brought to Benin, yields have increased dramatically for both grain legumes and cereal crops. The process decreases the amount of nitrogen fertilizer required for cereal crops, which means farmers spend less on production.

The process of nitrogen fixation has long been known as one way for nature to improve soil fertility in farmers' fields. Legumes planted in a field absorb nitrogen (N) from the air and convert it, through a natural biological process involving nodules that form on its roots. They then leave that nitrogen behind in the soil after they are harvested, meaning for the next season's planting, farmers need much less nitrogen fertilizer for the subsequent crop. Except, there is often something missing from this scenario. For nitrogen fixation to work, the right bacteria must be present in the soil to make those nodules grow in the first place.

The Joint Division, in part through the IAEA's technical cooperation programme, has promoted cropping systems that add nitrogen to the soil through nitrogen fixation since the 1960s. The process calls for introducing legumes into crop rotations and inter-cropping. Farmers who have adopted this system have seen enormous increases in their yields as they have alternated legumes with their cereal grain crops.

The Joint Division, through work in its laboratory in Seibersdorf, Austria, has also identified the specific bacteria needed for legume roots to produce the nodules that fix nitrogen – bacteria that will initiate the process of helping the roots form nodules. Researchers can quantify this process with an isotopic technique that calls for the addition of N-15 isotope fertilizer to the soil to measure how much nitrogen the legume absorbs from the fertilizer and the soil, and how much from the air, so the amount of fertilizer can be adjusted if needed. Scientists also use this method to determine which legumes perform best in improving soil fertility and increasing crop yield in any specific cropping system.

Maize yield increases 50 percent

In Benin, maize is by far the most important crop, grown by 90 percent of family farmers and occupying more than a third of the 2.2 million hectares of arable land in the country. By initiating crop rotations between maize and nitrogen-fixing legumes such as soybean and groundnut, maize yield has increased 50 percent. In addition, the legumes chosen for the rotation did more than add nitrogen to the soil, with yields of both soybean and groundnut doubling. Even animal productivity and health have improved with this process, because the animals are fed with the legumes grown in more fertile soil, so their feed is also more nutritious.

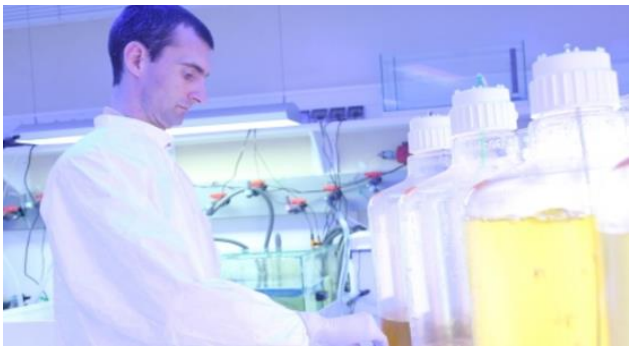
The lab in Benin that produces the inoculum has grown to keep up with demand from satisfied farmers and to accommodate other farmers who want to initiate the process in their fields. The laboratory also has become a hub to train scientists from other African countries in inoculum production.

Since this programme began, more than 5 000 farmers have been trained at the Faculty of Agronomic Sciences at Benin's University of Abomey-Calavi. Farmers are encouraged to use

inoculant technology along with nitrogen fixation to improve soil fertility and increase crop yields. The area of nitrogen-fixing legumes included in cereal cropping systems increased from 2 200 ha in 1999 to 30 000 ha in 2016. Not only has planted area increased, the Benin farmers who improve their soil's fertility through nitrogen fixation now save a cumulative US $4 million on fertilizer costs each year.

HOW DO OCEAN POLLUTANTS MAKE THEIR WAY INTO OUR SEAFOOD?

污染物如何進入我們的海洋？



Pollutants may seem to disappear into the ocean to never be seen again, but for many contaminants, it is only the beginning of their oceanic journey up the food chain to people's dinner plates. To tackle this problem, scientists at the IAEA's laboratories are studying how these contaminants are taken up by different marine organisms, how they make their way through the marine environment and how they are processed by the human digestive system. Their research findings will help scientists worldwide assess the risks of eating contaminated seafood, and help government officials establish and maintain seafood safety regulations.

"Many people treat the ocean like a sink, considering it a final resting place for pollutants, but some of these pollutants can find their way into our seafood," said Marc Metian, a research scientist at the IAEA's Environment Laboratories. "Using nuclear techniques we can examine how contaminants move through the food chain from marine algae all the way to predator fish, and we can also assess the impact it can have on people who are eating these fish."

Since the industrial revolution, ocean pollution has increased steadily. Around 80% of pollution comes from land, including agriculture, heavy industry, untreated sewage and litter like plastics. These pollutants can jeopardize seafood safety, which can affect the lives and livelihoods of more than three billion people who depend on the ocean as a source of income and food, according to the United Nations.

Tracking pollutants through the food chain using radiotracers

Scientists at the IAEA develop and use techniques using radiotracers to better understand how contaminants move through the marine food chain. Radiotracers are chemical elements, either natural or artificial, that have a unique signature, almost like a fingerprint. They can be used to study natural processes like the flow of water, bone growth rate as well as trace the movement of different

substances. They can also be used to track contaminants in the marine environment, such as metals like mercury or cadmium; radionuclides, such as caesium and americium; and organic pollutants, such as polychlorinated biphenyls (PCBs) and pesticides. The scientsits have also developed a way to replicate the human digestive process in the laboratory by creating a mix of enzymes. This allows them to observe which contaminants are broken down during digestion and which remain in the system.

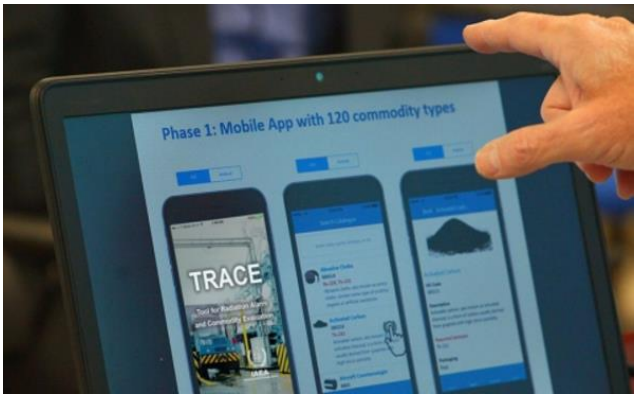
Tracking the flow of contaminants is particularly important for keeping people safe, Metian explained, as the contaminant concentration levels can increase the higher up they get in the food chain, potentially putting people at risk. This amplification process is known as biomagnification. This is a process where contaminants enter the environment and are absorbed or eaten up by small organisms, which in turn are eaten by larger organisms. These contaminants then accumulate in the organisms and their concentration increases. Animals like tuna, whales, and even humans face a greater risk of toxins and contaminants building up and posing a health threat.

Science-based data for safer seafood

Scientists use radiotracer techniques to study diverse contaminants, organisms, and radioisotopes to develop a comprehensive understanding of how to effectively deal with toxins and pollutants. Their findings provide the science-based information experts need to develop and maintain effective national seafood safety regulations to monitor contaminants and protect people.

IAEA LAUNCHES MOBILE APPLICATION TOOL FOR RADIATION ALARM AND COMMODITY EVALUATION

國際原子能總署推出用於輻射警報和商品評估的移動應用工具



An app launched by the IAEA today helps customs officers determine whether radiation alarms going off at border crossings are sparked by naturally occurring radioactive material in goods such as ceramics, fertilizer and soy beans, or whether the alarm could indicate smuggled material, warranting further inspection.

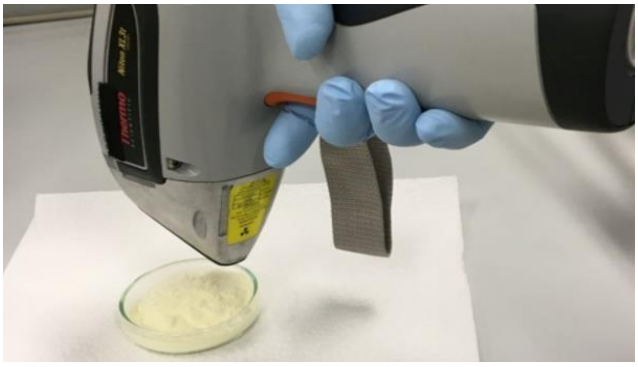
The mobile application Tool for Radiation Alarm and Commodity Evaluation (TRACE) provides

detailed information to help assess radiation instrument alarms. Fast and accurate assessment is important to minimize the impact of innocent alarms on normal operations, and to enable customs officers to focus on potential transboundary movement of nuclear and other radioactive material out of regulatory control.

The app, developed as part of an IAEA-led coordinated research project that involved experts from more than 20 Member States, was developed using information on commodities and isotopes collected by radiation portal monitors. It is available for download on Apple and Android devices.

NEW IAEA PROJECT LOOKS AT PORTABLE DETECTION EQUIPMENT TO HELP PREVENT FOOD FRAUD

新國際原子能總署計畫使用可攜式偵測設備預防食品欺詐



The IAEA has launched a project to enable countries to quickly detect food fraud and contamination with the help of low-cost, portable tools.

The coordinated research project, run in cooperation with the Food and Agriculture Organization of the United Nations (FAO), brings together scientists from 13 countries to explore opportunities created by advances in field-deployable analytical equipment.

Fraud is estimated to cost the global food industry between US $10 billion and US $15 billion every year, affecting around 10 per cent of all commercially-sold food products, according to the United States-based Grocery Manufacturers Association.

"The development of high performance hand-held computing devices, such as smart phones, has enabled a new generation of instruments that can be used outside the traditional laboratory environment," said Iain Darby, head of the IAEA's Nuclear Science and Instrumentation Laboratory.

Ion mobility spectrometry, a nuclear-based technology used by border police in the detection of illicit drugs and explosives, is one of several methods that could be adapted to perform point-of-use screening tests to check for adulterants, contaminants and mould in food.

The project will develop methods for using such hand-held devices to test food authenticity,

including guidelines for analyses and a comprehensive database of authentic reference samples – a critical requirement for reliable assessments of food provenance and composition.

Participating countries are Austria, Belgium, China, India, Malaysia, Morocco, Russian Federation, Singapore, Sri Lanka, Sweden, United Kingdom, Uganda and the United States. The project kicked off with a meeting in Vienna in May, and first results are expected within the next two years.

"The goal is to make available low-cost devices and methods for food authorities to use directly in the streets and markets, particularly in developing countries," said Simon Kelly, a Food Safety Specialist at the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, who leads the project.

While professional research laboratories have the ability to detect different types of fraud and contamination in food relatively quickly, such capacity is often limited in many countries.

"Labels and paperwork are what countries often depend on, and these can be forged," said project participant Jose Almirall, Director of the International Forensic Research Institute at Florida International University. "We need to rely on science to provide assurances."

"Food fraud cases often remain hearsay and recurring due to lack of proof and convictions," said Syahidah Muhammad, Head of the Stable Isotope Laboratory at the Universiti Sains Malaysia. Portable tools and standard operating procedures will allow authorities to respond faster at critical checkpoints, and protect the food supply chain from being inundated with tainted products, she added.

The project will initially focus on devising methods to quickly analyse milk powder and vegetable oil, two commodities that are particularly vulnerable to adulteration. For example, "gutter oil" – waste cooking vegetable oil that is recovered and recycled back into the food chain – has raised alarm in several countries.

Food adulteration can pose a significant danger to public health, and the loss of public confidence in food products can lead to international trade bans and severe economic damage.

"We are always waiting for the next big scandal to happen, and hope that it will not have an impact on health," said Kelly. "Authorities often find themselves under public pressure, while not being adequately equipped with screening technology that can stand up to the challenge of uncovering food fraud. We need to have easy-to-use methods in place."

The project is benefitting from two portable spectrometer machines purchased thanks to a contribution from Germany to help modernize the Agency's nuclear sciences and applications laboratories.

The IAEA, jointly with FAO, helps its Member States use nuclear and related techniques for science-based solutions to improve global food

security and sustainable agricultural development.

STINGING WASPS REPLACE CHEMICAL PESTICIDES BECOMING CONTROL AGENTS IN FIGHTING STABLE FLIES

黃蜂代替化學殺蟲劑成為控制飛蠅的新利器

Costa Rica's position as the world's largest producer of pineapple brings with it a parallel problem for the country's livestock and dairy industry. Its pineapple processing plants are surrounded by mountains of pineapple residue, and that residue provides a breeding ground for the aggressive, blood-sucking "stable fly", a fly that can wreak havoc on cattle and affect their productivity. In an effort to control the fly without resorting to chemical sprays, the Costa Rica Institute of Agricultural Technology Research (INTA-MAG) with the support of the Joint FAO/IAEA Division identified another way to do the job – using a wasp. Not just any wasp. This wasp is a "biocontrol agent", a natural enemy of the stable fly that does no harm to the environment. The extensive experience of the Joint Division in the use of irradiation in biocontrol and in insect mass rearing has made this an ideal partnership.

The stable fly got its name from its habitat. Known scientifically as Stomoxys calcitrans, the stable fly hangs out almost anywhere that horses, cattle and other agricultural animals can be found. A bit smaller than the common housefly, its stinging, blood-sucking bite stresses the dairy and livestock cattle it attacks and can lead to anaemia, weight loss and reduced milk production.

Costa Rica's dairy and livestock sector has a particular problem with the stable fly because of the country's position as the world's largest producer of pineapple. The stable fly lays its eggs in pineapple residue and, when the new flies emerge, they fly off in the direction of the nearest cattle or dairy farm. Efforts to control the stable fly with pesticides can have public health or environmental impacts.

Now, there is a new player in the control game, the Spalangia, a tiny parasitoid wasp. Parasitoid, not to be confused with parasite, refers to an insect that attacks other insects, which is exactly what this little wasp does. It lays its eggs in stable fly pupae. Upon hatching, the wasp larvae feed on their host – they consume the stable fly pupae. This means that the wasp is born but the stable fly never emerges. It all

happens naturally, hence the Spalangia is called a “biocontrol agent”.

The Joint Division, in part through the IAEA’s technical cooperation programme, has provided scientific support in the development and use of nuclear techniques to enhance biocontrol against insect pests. For example, it supported the Moscamed Program in Mexico in developing the mass production and release of other wasp species to control fruit flies that threaten the country’s horticulture sector. Now, in supporting the Ministry of Agriculture (MAG) of Costa Rica in adapting the methodology for stable flies, it facilitated the establishment of a facility to rear the needed numbers of Spalangia, allowing testing of the method at pilot level in dairy and beef farms.

Irradiating stable flies provides extra safeguard for wasp release

In order to make this happen, researchers from INTA-MAG, with support of the Joint Division, rear stable flies and wasps side-by-side. This method requires bringing a colony of stable flies into the facility and using its pupae to rear the wasps. When the wasps become adult, they are released in areas where pineapple processing facilities are in proximity to dairy and beef farms. Once the process is started, the wasps naturally seek out stable fly pupae to lay their eggs, so the process of controlling the stable flies continues quite naturally.

There is also a prequel to this scenario. When the INTA-MAG laboratory rears the wasps using the stable fly pupae, it cannot be sure that wasps will lay their eggs in every single pupa, meaning there is a chance that some stable flies themselves will actually emerge. Thus, the researchers use gamma rays to irradiate all of the stable fly pupae before the wasps come to lay their eggs. That way, even if a few stable flies emerge, they will be sterile, so no progeny, which further assures an effective biocontrol programme.

This has proven to be a safe and cost-effective approach, reducing the need for potentially dangerous and costly chemical insecticides. In addition, animal health, and milk and meat production improve when they are no longer under attack by stable flies. Building on its successful implementation, the Costa Rican Ministry of Agriculture is putting the information produced and techniques developed into a national action plan to suppress stable fly infestations in affected areas throughout the country. Looking ahead, the stable fly is found worldwide and breeds on residues other than pineapple, meaning there are many countries that will be able to take advantage of this methodology for pest control. And as for Spalangia, they neither sting nor bite livestock or humans.

JAPAN STATE MINISTER FOR ECONOMY, TRADE AND INDUSTRY MR YOSUKE TAKAGI VISITS THE NEA

日本經濟貿易部長訪問 NEA

On 4 May 2017, Mr Yosuke Takagi, State Minister for Economy, Trade and Industry and Head of the Local Nuclear Emergency Response Headquarters of Japan met with Dr Daniel Iracane, NEA Deputy Director-General and Chief Nuclear Officer, and Mr Masahiko Fujihara, NEA Deputy Director-General for Legal Affairs and Strategic Resources, to discuss nuclear decommissioning activities in Japan and around the world. The discussions addressed a wide range of associated issues, including updates on the decommissioning operations at the Fukushima Daiichi site, ongoing international joint activities and global trends in decommissioning. Both parties underlined the importance of strengthening international collaboration in the face of the unprecedented challenges posed at the Fukushima Daiichi site. The NEA has a number of current and proposed post-Fukushima joint projects and activities in the areas of accident analysis, fuel debris characterisation and radioactive waste management. Mr Takagi expressed that Japan would continue to contribute to these projects.

MANAGING NON-NUCLEAR RADIOACTIVE WASTE

管理非核子放射性廢棄物

On 2-4 May 2017, the NEA held a workshop on Management of Non‑nuclear Radioactive Waste to discuss the regulatory and operational aspects of non‑nuclear radioactive waste management, as well as different national approaches. Hosted by the Italian Institute of Nuclear Physics (INFN) Legnaro National Laboratories (LNL), the workshop was attended by more than 100 experts from 31 countries, including 10 non‑member countries. All NEA member countries, including those that do not operate nuclear power plants, must manage radioactive wastes generated by activities unrelated to the production of nuclear energy, including national laboratory and university research activities; used industrial gauges and radiography sources; and wastes from nuclear medicine activities. Participants examined the various challenges of non-nuclear radioactive waste management, including funding issues for small programmes, development and maintenance of technical experience, stakeholder involvement and safety case development and assessment for waste disposal installations. They agreed that the management of non-nuclear radioactive waste poses special challenges for non-nuclear power countries because these countries often lack the waste management infrastructure, funding, and operational and regulatory experience of countries with nuclear power programmes. The discussions underlined the added value of sharing of knowledge and national experiences in managing non-nuclear waste in all its sources and forms.