The CABI Podcast: The desert locust

Audio Transcript

Joanna
Locusts and grasshoppers can decimate crops in many parts of Africa and Asia with locusts responsible for invading in swarms of millions – leaving behind ravaged fields and putting livelihoods and food security at severe risk.

Joanna
Welcome to the CABI podcast. In this series we're focusing on invasive species. I'm Joanna.

On this episode of the CABI podcast we're talking about the invasive insect, the locust and in particular, the desert locust, with CABI expert guests Drs Belinda Luke and Ivan Rwomushana.

Belinda
I'm Dr Belinda Luke and I've been working for CABI for the last 24 years. And part of that time has been looking at locust control. My first job when I started at CABI was working on the Lubilosa project, which was looking at the biological control of locusts and grasshoppers in Africa. And when I started 24 years ago, I was in the labs carrying out the lab experiments related to the fungus that controls locusts.

Ivan

My name is Rwomushana Ivan. I'm a senior scientist for invasive species management. I've been working in CABI for the last three years and I'm based at CABI Africa regional centre in Nairobi, Kenya. My background is entomology and lately working on integrated pest management of invasive species and in the recent months I've started doing some work on locusts.

Joanna
It's known that there are over 20 different types of locust. They belong to a family of grasshoppers but what is interesting is that all locusts are grasshoppers, but not all grasshoppers are locusts!

Belinda
Locusts have been a problem since biblical times and where they have, they swarm, they come in and they eat all the crops in that area. On average, they swarm every seven to 10 years in the recent sort of 50 to 100 years, and when they come in, they will literally eat any green vegetation that's in their way.

Joanna
The main difference between locusts and other grasshopper species is their ability to change their colour and their behaviour which takes place during their lifecycle. Two factors true to the desert locust.

A desert locust has two types of behaviour – solitary and gregarious. Something we'll find out more about now…

Belinda
Normally desert locusts are solitary. They don't like to be near each other. But when you have very favourable conditions, so you had the rains that came in, that meant that the eggs – more eggs actually hatched, and then you will then have this density of locusts. And because the locusts are together, what happens is that they rub each other's back legs and that stimulates them to move from a solitary phase into a gregarious phase. And it's quite striking because they actually change body colour, as well. So normally when they're in the solitary phase, they're brown, they hide in well within the environment, so it's difficult to see them. In the gregarious form, they turn to black and yellow, as nymphs, and then they go a pinky colour when they're adults.

Joanna
So, we know desert locusts would usually live a solitary life on dry ground where they'd act as individuals. But, a change in the weather – increased rainfall and warm temperatures – make perfect breeding grounds and the number of desert locusts soon multiplies and they take on a gregarious behaviour. But how does this happen?

Belinda
So, it's a combination of more eggs are being hatched and then also when they're coming together, they're being stimulated by the rubbing of the back legs, which releases hormones and then that attracts more, because these – sorry, pheromones are being released and then you get these large groups that will swarm together. And swarms can come together to form really big ones, or they can separate so it's quite a fluid relationship that they've got.

In 2018, there were exceptional rains that led to three generations of locusts going unnoticed and they went unnoticed because locusts lay their eggs in undisturbed areas where it's very quiet, there aren't very many people there.

Or they're in war-torn areas. So, for example between the border between Pakistan and India, where you're not getting many people because of safety reasons. And then when those outbreaks, those three generations weren't noticed and then they come together, and then they move to a gregarious form, so they all join together and that's when the outbreak started, at the very end of 2019 and then into 2020.

Joanna
Attracted through pheromones, as Dr Belinda Luke explained, the desert locusts become gregarious, breed quickly and create large groups known as hopper bands – the young locusts without wings - or swarms – the adults with wings.

You'll find these bands on the ground, within shrubs and vegetation and you'll easily see the swarms in the air!

Being highly mobile and known as a transboundary pest, where conditions suit – favourable weather and abundant green vegetation – swarms of locusts easily migrate in search of food, forming swarms the size of countries!

Belinda
Locusts range across the world but the desert locust is mainly found in sub-Saharan Africa, the Middle East and Asia. And it's around about 30 countries. When you have outbreaks, then those locusts can invade up to 60 countries and they cover a fifth of the Earth's landmass as well. And they can go as far north as Spain, and they can go across as far as China.

Ivan
On average a swarm size can be about 40 million locusts. That's an average, it could be more than that. And so, our readings, some quick calculations and to try and give you an indication of actually how big these swarms can be. If you imagine that a typical locust, I mean a female, lays about three times in her lifetime. And each time she lays, you get about 200 – 250 eggs.

So, if you have a swarm of 40 million locusts, and each female, assume that half of those are females, so you'd – if they went through one cycle, you're talking about 12 billion individuals of desert locusts.

Joanna
Desert locusts can feed on over 400 species of plants, destroying pasture and food crops, almost any vegetation in their sight. In fact, a very large swarm can consume as much food that would usually feed approximately 35,000 people per day which is equivalent to a small town or city!

And, it's their persistent drive to eat and reproduce that is devastating food security and livelihoods.

Ivan
From literature, it shows that locusts can consume as much food as their weight per day, which is about two grams. So, if you can try to quantify that you can get an indication of how much these locusts consume in their relentless drive to actually eat and reproduce. In a country like Kenya a recent survey has shown that on average 77% of crops were actually damaged by desert locusts, by the swarms.

You can imagine if each swarm contains up to 20 million locusts and you have 534 swarms, this is quite substantial in terms of their quantity of locusts in the environment and how much they can consume and how that affects livelihoods and food crops for humans and livestock.

Joanna
During 2020, the desert locust was of particular concern in Africa where large outbreaks occurred primarily in the Horn of Africa and Eastern Africa. But why?

Belinda
It has been recorded in this latest outbreak that some of the swarms have been several hundred square kilometres in size. I mean, they are massive, massive swarms that we're talking about.

Ivan
For locusts to thrive you must have the perfect weather. If it is moist and there's a bit of rain and the vegetation is green because they have lots of food to eat so they will thrive. But also, they need perfect breeding sites and, I mean, in the past we all knew that these breeding sites were apparent and prevalent in countries like Somalia and Ethiopia, but we do have these same breeding sites in Kenya.

And that could explain why since December, the desert locust problem is still with us because the weather has been perfect, just been raining like every other day, and so it's pretty much all green there.

And also, there's a quite a number of breeding sites in northern Kenya. And so, this provides a good environment for desert locusts laying and completing their cycle. And so, you get a continuous cycle of breeding and multiplication and reproduction and this is what has happened in some of the countries in eastern Africa and is currently some prediction that we could have desert locusts last for a very long time. Because they found a perfect a breeding ground where everything seems to have fallen in place.

Joanna
The world is now witnessing growing incidents of the new 'normal' caused by climate change. Has climate change had an effect on the size of swarms in Africa, their frequency or any other impacts?

Belinda
We can be sure that climate change is certainly warming up and our data in Africa, because we've got 20 years' worth of data, shows that it is, the temperature is increasing. So that will have an effect on the speed that the locusts can go through their development stages to become adults.

And we also know that because of climate change, you get more erratic weather patterns. So, you'll get unusual rain patterns, which is what triggered the outbreak for 2020 was unusual rain patterns in 2018. So, we certainly know that climate change is having an effect. How much it's having an effect on how often locusts will swarm, we don't know yet.

Joanna
25 million people across Africa are now facing acute food insecurity due to the desert locust plague in 2020. So, what can be done?

Swarms this size can be difficult to manage and control. Quick interventions such as chemical pesticides can work by spraying the adults that are flying within swarms but this method can be costly, it's not sustainable, nor do they manage the problem long-term.

Chemical pesticides can also be harmful to humans, livestock and other beneficial insects and cause ongoing damage to the environment.

Ivan
Pesticides are commonly being used for desert locust control, you have to understand that they use a special kind of pesticide – Ultra Low Volume pesticides. And to get, to understand what this means is that this is a pesticide that is highly concentrated, it's not mixed with water or like emulsifiers like other concentrates are done, but it's used in its pure form and so you're basically spraying the high concentrate pesticide in the environment whose impacts on other natural enemies like bees and pollinators and others can be quite significant.

Belinda
We've all seen clips on the TV of the locust outbreaks this year where a spray plane's gone over and then you've had local people going up and picking up twitching, dying insects. So, it is a big problem with chemical pesticides being inadvertently picked up by local people. And also, its knock-on effects like the cattle will eat vegetation that's been sprayed with the chemical so there it's passed on to the milk which is then passed onto people who drink it. Same with things like hens who will lay eggs. Again, that will then be passed onto humans who eat the eggs.

Joanna
Ideally, to control locusts from reaching swarm size, early action and prevention is required – two key areas CABI has expertise in when managing invasive insects.
Early control will help to manage the desert locust and one approach within this phase is the use of biopesticides. A biopesticide is a natural form of pesticide derived from fungi, plants or bacteria.

Biopesticides can kill locust adults and hoppers, however, it is best to attack the locusts whilst they are hoppers, stage two of the lifecycle of a desert locust. Belinda and Ivan tell us more…

Belinda
Biopesticides work really well because you can spray it on the hopper bands. The biopesticide takes seven to 14 days to kill in the field. But because they aren't flying, the

locusts can't fly until they become mature adults. That means you've got enough time to kill them before they can move to cropland.

Ivan
I can tell you that the best way to control desert locusts is targeting the hoppers because they are still young, they're still delicate and so they are highly susceptible but most importantly if you think about size of the hopper bands, the size of the hopper band, the size of the desert locusts in immediate area you will have more hoppers than you would have the mature locusts and so in terms of efficiency, a strategy which targets identifying where locusts are breeding and killing the hoppers is a more effective strategy than trying to target adult populations that have matured and are moving around migrating from place to place.

Joanna
CABI is working hard to help fight this highly invasive pest through a number of projects. Using CABI's extensive experience and knowledge in biocontrol, one of the projects developed a safe and effective biological control product, a biopesticide, which specifically targets locusts and is environmentally friendly.

Based on a fungus, the product which is now licensed as Green Muscle, is mass-produced by Elephant Vert and is helping to tackle the desert locust problem in Africa and Asia. But how does Green Muscle really work?

Belinda
So, the fungus is naturally occurring in the environment and it was actually isolated from a dead locust in Niger quite a few years ago. And CABI along with partners such as IITA and a big consortium under what was called the Lubilosa Project which is French for biological control of locusts and grasshoppers.

And the fungus was isolated and then it was – what effectively we're doing with the biopesticide is we're mass-producing it, we're putting lots of spores onto the locusts that are in the field, whether they're nymphs or whether they're adults.

So, the fungus has to come into contact with the locust and once it does, it will pick up on chemical cues, Is this a locust? Yes or No. So, for example if it lands on a bee, if it lands on a lizard, it's not going to grow because it hasn't got the stimulus. So Green Muscle is specific only to grasshoppers and locusts.

Once it touches that locust, it will then start to grow. Within 24 hours, it will have physically pushed its way through the cuticle of the insect and will start growing in the inside of the insect, in what's called the haemolymph. It then mass grows inside the insect and then effectively it's eating the insect from the inside out.

Joanna
And what about the long-term effects and how does Green Muscle compare to chemical pesticides?

Belinda
So, the fungus is naturally occurring, it is very specific to locusts and grasshoppers. And once the locusts are dead, they can then break open, release more spores which can then

go on and infect other hopper bands. So, what you often find with spraying something like Green Muscle is that new locusts and hopper bands coming into that area will pick up the spores that are left on the vegetation or pick up the new spores that are released from the dead insects, and then that will kill them.

Ivan
One good benefit of using biopesticides such as Green Muscle is that of course in over the longer time it has a better effect but once locusts pick the fungus, they fall sick. And once they fall sick, they're going to eat less and when they eat less of course they're getting less of the vegetation consumed. They also become weak and so when they're weak they become susceptible to predation by other bugs and natural enemies, lizards and the like can predate upon them.

And so, locusts are cannibalistic. They feed on each other and so when one is sick, the stronger one will feed on it and also get infected but this and as a consequence of course the infection spreads from one insect to another. One locust to another and you get a better effect.

Belinda
But if you spray with a chemical pesticide, you have immediate knockdown within one day but over the course of about 14 to 20 days, the numbers actually have increased back up to the control treatments, because new hoppers coming in aren't being killed by the chemical. So, you get a longer-term control with Green Muscle.

Joanna
So, are there any ways other than pesticides and biopesticides to control the desert locusts? Local communities do have other theories…. Eating them, even making noise. But do they work?

Ivan
In countries in Eastern Africa, there's been some talk about eating locusts as a way of controlling them because lots of communities in Africa are known to consume insects in entomophagy and this is something that has been fronted but the scale of the desert locust invasions and if you recall my 12 billion number, I mean, you can't consume and you can't collect and consume 12 billion insects.

So, communities may make an attempt to control by consuming them, but they can only consume so much. And so that doesn't seem to work as a – I mean, it wouldn't work nicely as a control measure. Of course, when the locusts land in the fields, local communities also go to the field and scare them with maybe make noise, they blow whistles and the like, but this is not known to control them. All you're doing is basically scaring them away but they're still going to remain alive and move to the next field.

And of course, when you do that, you're also breaking up bigger swarms into smaller swarms that are going to move in other directions and cause more damage. So, in the long run, I think biopesticides are the most strategic way of dealing with desert locusts.

Joanna

Mitigation is vital to combating the desert locust but one other problem is reaching the insects. Ivan is Project Manager for a CABI project which is piloting the use of drones to spray biopesticide, to reach locusts that wouldn't normally be reached by traditional aircraft spraying. Ivan tells us more about this project…

Ivan
And so, our approach is to target immature hoppers, the immature locusts, the hopper stage, rather than the flying locusts because they are more susceptible to infection by the biopesticide. But also, over a unit area, if you can think of the size of a mature locust and the size of a hopper, in terms of size, you get more hoppers in a unit area than you get in terms of mature locusts. So, in terms of efficiency, it's much better.

And so we are looking at the drone and trying to see how efficient it is to deploy biopesticide using drones, and experimenting with things like flight time, how much time we need to fly, to get a certain level of efficiency, how much payload you need versus time to optimise the use of the drone, how much biopesticide they need to spray in terms of the spray rate, how much speed you need to fly the drone, the spacing you need to have the height above the ground.

We've been experimenting at heights of 2.5 metres all the way up to 50 metres and seeing how that influences the swath width and how much coverage of the biopesticide you're going to get. And so that is something that we are currently working on.

Joanna
Are there any outcomes from the work done so far?

Ivan
Well, some of our observations from this work, of course we've noted that spraying hoppers is much better than targeting the mature locusts because hoppers don't fly as much. They're easier to track and it's easier to determine the efficiency of your kill operation because after spraying you will wait a number of hours and then have a number of quadrants and estimate how many locusts have been able to be killed. And even though some of the hoppers are in thick bushes and rocky areas, we are able to fly the drone as much as possible to the target and so the penetration is actually better.

And from the last mission that we did on trying to experiment with a drone, we've been getting anywhere close to 75% efficiency. So, it has ranged from about 47% to 97% kill rate, and so on average comes to about 75% efficiency. So, we think that this is a promising approach in terms of desert locust control in the future, in Kenya and other countries where locusts are a big problem.

Joanna
CABI is continuing its work on the effective management of locusts through our project work which includes forecasting and monitoring of locusts in China and Laos using data gathered from Earth Observation and environmental data, a project Belinda has worked very closely on. An integrated response project has also helped over five million farmers battle the desert locust through a targeted mass multi-media communication campaign.

To find out more about these projects and CABI's work on locusts, please visit cabi.org/locusts.

Thank you to our guests Dr Belinda Luke from the CABI centre in Egham in the UK and Dr Ivan Rwomushana from the CABI centre in Kenya.

This podcast is a CABI production and was presented by Joanna Slezak and edited by Tom Swindley.

For more information about CABI and our wider work, please visit cabi.org

And we'll see you next time on another episode of the CABI podcast.