NEWSLETTER FOCUSSING ON INNOVATION IN THE AMENITY SECTOR

AMENITY INNOVATION

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StadiaPitch demonstration centre at STRI

DR RUTH MANN
DIRECTOR OF RESEARCH AT STRI GROUP

PROF ALAN C. GANGE
BIOLOGICAL SCIENCES ROYAL HOLLOWAY UNIVERSITY OF LONDON

DR PENNY HUNDLEBY
SCIENTIST AT THE JOHN INNES CENTRE IN NORWICH

INNOVATION & RESEARCH IN AMENITY MANAGEMENT

At our 2020 conference, in the discussions, it was suggested that the Forum might look to produce an occasional publication focussing on innovation and research in amenity management. Undoubtedly much is happening in all aspects of weed, pest and disease management and a publication such as this was seen as giving opportunity for all in the sector to hear of particular projects and innovations.

So I am delighted to introduce the first edition which contains three articles which we hope all will find of interest. We would be delighted to receive offers of further articles for future editions as well as feedback on this first edition. Please email Admin@amenityforum.net

Thanks are due to Kate who has brought this publication together and to Laurence Gale for his professional advice. We are all in extremely challenging and, in many ways, unprecedented times and the need for innovation and new ideas has never been greater.

If anyone is reading this and is not fully aware of what the Amenity Forum is or its activities, please do visit our website. The Amenity Forum is a UK wide initiative bringing together all involved in amenity management to promote best practice and demonstrate the important and essential role of all involved. What happens in amenity impacts upon every UK citizen every day seeking to create safe, healthy and sustainable amenity and sports surfaces fit for purpose. If your organisation is not yet a supporter of the Forum and, through it demonstrating its commitment to best practice, we urge you to do so and ensure the important role played is fully recognised by all.

ANNUAL AMENITY FORUM CONFERENCE

Facing the Future

Thursday, 21st October 2021
Kettering Conference & Leisure Village,
Thurston Drive Kettering, Northants, NN15 6PB

Have you been to the Amenity Forum Conference?
Why not come along to this year's event or join us on Zoom.

The 2021 event is entitled 'facing the Furture'. It will provide opportunity to hear first class speakers who will seek to address the issues and challengesgoing forward. The exhibition area always proves popular in catching up on new products and innovations.

To book a place at the conference, please contact Kate at **admin@amenityforum.net**

Automated guided vehicles moving the turf modules

INNOVATIONS IN SPORTS, LAWN AND URBAN GREEN SPACE SECTORS

Dr Ruth Mann,
Director of Research at STRI Group.

We all want more in every aspect of our lives. We want smarter ways to use the environments we live in. We want to recycle more and minimise inputs and we want it to enhance our lives. We know technology is now available to do this. We all like the data in our smart phones and devices clocking up reams of information about us. How many steps we take, how long we slept, our calorie output, etc. We can use this information to help us determine what exercise we should take, what our calorie input should be and how we can improve daily routines to make us perform better.

The same is happening in the sports turf, lawn management and urban green space sectors. We want more out of our sports stadia. We want them to be multi use allowing different sports to be played on a natural pitch while still housing concerts or motor sports. We want our home lawns to be lush green and dense all year, good for entertaining family and friends. We want to install and manage green and blue roof systems providing flood reduction, cooler air and increased biodiversity. However, we want the amount of time, inputs and expense associated with these improvements to be minimised and as automated as possible. Therefore, we must look to innovative technologies to help us achieve these goals. This article looks at three current innovations using technology to enhance sports turf, lawn and urban green space management.

StadiaPitch

StadiaPitch is a modular multi-event sports pitch with a unique storage solution. Currently, stadia cover the pitch during concerts, which kills the grass underneath, requiring complete renovation to return the pitch to natural turf sports. However, StadiaPitch, developed by Bosch Rexroth and designed, built and tested by the STRI Group, utilises a modular hybrid natural grass system which is transported from the arena floor to pitch storage area by automated guided vehicles (Plate 1). Once stored, the pitch is maintained as normal ensuring the sports turf is always in a playable condition and ready to be reinstalled. The underlying concrete floor can be used for many other opportunities, such as concerts, motor shows, corporate events and fashion shows. The pitch can be stored outside of the venue at floor level or on elevated platforms

StadiaPitch demonstration centre at STRI

or within the stadium structure, as required. As the changeover time for the stadium is reduced to a matter of hours, it is possible to have multi-uses consistently throughout the year, making much greater use of the facilities within stadia. The StadiaPitch research and demonstration centre is located at STRI's headquarters in Bingley (Plate 2). This is the culmination of 7 years of research and development building on a concept developed by Nutcracker Solutions bringing together Bosch Rexworth, Hydro and STRI Group.

TurfSync

TurfSync is an online turf surface performance tracker providing turf managers with all important management data. Currently, it is used mostly by sport venue grounds teams, coaches and consultants to monitor the playing surface and identify trends and risks to solve problems before they occur. This is where the data trackers in your smart watch meet turf management. As an industry we often forget the importance of recording data. This could be performance data, nutritional inputs or pest activity, for example. Data are facts and if you store this information and can access it easily, it can aid you with your current and future management practices.

TurfSync is an easy to access portal, designed by STRI Group and Mashup Analytics to support turf managers across a wide variety of sports and turfgrass surfaces, in making informed decisions. Turf managers take and store surface performance data and set performance targets for their sites. This can be done with the help and support of the STRI consultancy team. For example, TurfSync is providing real time information to assist decision making around managing usage, allocating resources & planning capital works. It enables condition assessment to be undertaken using multiple criteria during the season, highlights issues, allows trends to be easily seen, and compares potential usage to actual usage to shows whether a sportsfield is being under or overused.

TurfSync's weather station also monitors a variety of different conditions. These include air temperature, humidity and surface wetness and automatically feeds this information into a cloud-based database for instant use on the TurfSync portal. This helps you to plan vital maintenance practices such as fertiliser applications and to forecast potential disease outbreaks.

The portal offers a visual aid, that has a traffic light system, with parameters that are set by you to assist you and your team when making decisions (Plates 3 and 4). The portal allows you to map the collected data onto a visual image, making it easy to identify problem areas and perform targeted management practices. Consistency is important across all aspects of turfgrass management. For example, golf club members want consistency across the playing surface and from green to green. Football and rugby players want to train on a sports pitch that represents the match day pitch. Turf growers want consistency of product maintained at equal quality across large areas of turf. Local councils want early warnings if sports facilities are being overused. TurfSync is the easy way to assess all of this! For example, Turf managers can collect firmness/hardness readings and aerate specific areas based on the data rather than blanket aerate or NDVI readings to determine the colour and density of the turfgrass.

Plate 5: Sustainable drainage system incorporated in a blue-green roof Sustainable drainage systems

Urban green space and urban water management

Green space solutions improve the quality of urban spaces for residents and can provide multiple other benefits for the wider area, for example providing a buffer for stormwater management (Plate 5). However, stormwater management of the wider urban environment is increasingly become a problem. Main sewage and

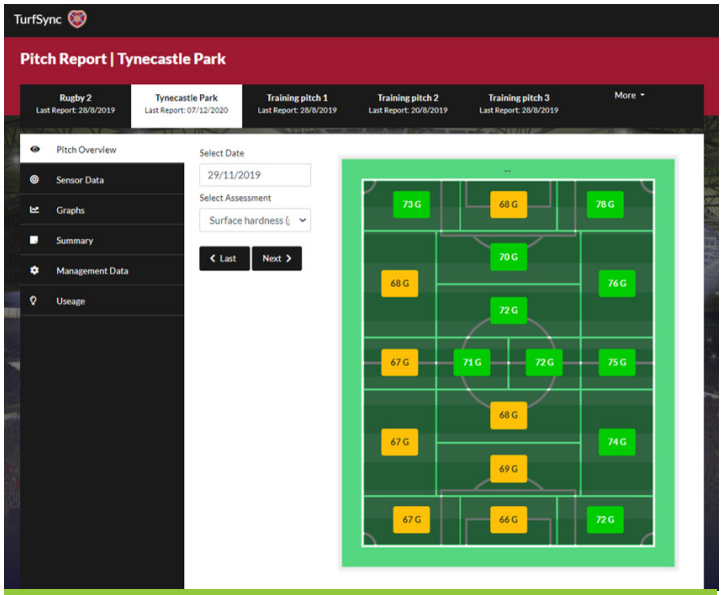

Plate 3: TurfSync showing the hardness measurement on a single pitch

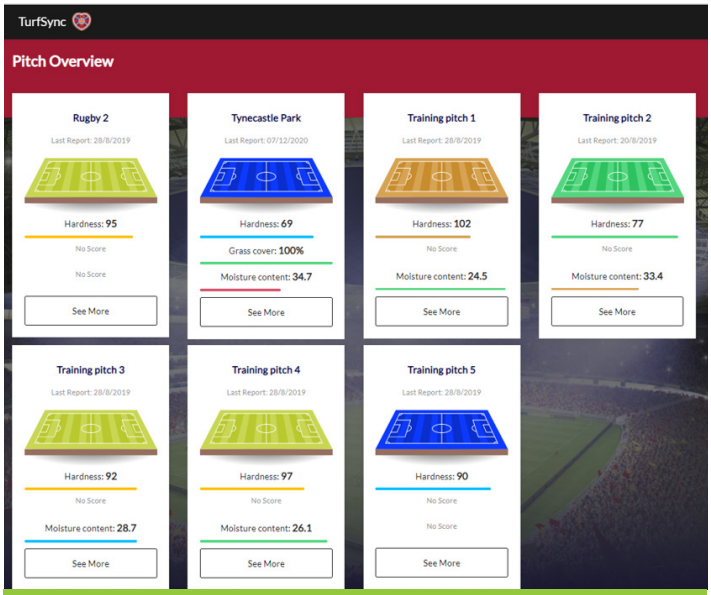

Plate 4: TurfSync overview of multiple pitches

old drainage systems are reaching capacity due to a number of reasons including impact of climate change on extreme storm events, increased development and less stringent design codes in years gone by.

(SuDs) are designed to store water during peak flow, and slowly release this back into the sewage network at a much slower rate, therefore preventing massive surges in water entering the system. One issue with conventional SuDs is that they usually require very large storage tanks as the system has to be designed to accommodate very large storms (often a 1 in 100 year event + 20 % for climate change). This means that these tanks are empty most of the time, except during these very extreme, but irregular storm events.

STRI are working with Mashup Analytics, EPG, Kisters and Polypipe to develop a smart SuDs system which allows much more efficient use of space in urban areas, and efficient use of drainage water. The smart tank control system uses accurate forecast data to predict storm events. This then sends a signal to the storage tank to release water in advance of the storm. Importantly the system only releases exactly the amount of water that is due to arrive in the storm and holds the remaining water back. Therefore, the system is full for the majority of time, making it much more efficient. This can then be used functionally as irrigation water or toilet flushing, rather than being discharged down the drain.

Therefore, smart green roofs, parks or home gardens with built-in water storage capacity takes pressure off both urban drains, and their capacity to absorb rain slows the flow greatly during the sudden downpours reducing associated flooding.

The system will help revolutionise the way that storm water drainage systems are designed on a city scale. Future systems, for example, will have the ability to talk to one another, and potentially move water around a city to where it is most needed.

Therefore, by collecting information on the turf and green space areas we manage and utilising these data, we can make maintenance decisions providing environmental and financial benefits to all.

BIOLOGICAL CONTROL IN THE AMENITY SECTOR

Prof Alan C. Gange,
Department of Biological Sciences,
Royal Holloway University of London

Introduction

The world pesticide market is worth around £18 billion per year. Using chemicals to kill what we regard as pests, weeds or diseases is not a new concept – evidence suggests that sulphur-based powders were used to kill moulds in ancient Egypt around 1500 BC. Late 19th and early 20th century pesticides tended to be highly toxic and persistent compounds such as lead arsenate and methyl bromide, but it was not until the development of DDT in 1939 that the age of synthetic pesticides dawned.

Many people think that the world uses too much pesticide. They cite perfectly valid reasons such as the economic and environmental costs, harm done to non-target organisms and that most pests and diseases rapidly develop resistance to the chemicals. However, it is also a fact that a staggering 21% of global wheat production, 30% of rice and 25% of maize is lost to pests and diseases each year. Without the use of chemicals, we could not feed the human population as it stands, let alone that projected for the future.

Generally speaking, pest and disease control in the amenity sector involves the use of chemicals first developed for agricultural purposes. This makes economic sense, but it is also an area of potential concern, given that the public is perhaps more likely to encounter the area being sprayed, through recreational activities in particular. Thus, it follows that we should seek alternative methods of pest control in amenity areas.

Biological control

Biological control is an alternative to chemical control and involves the use of natural enemies to control populations of a pest, disease or weed. Similar to chemicals, it too has a long history; articles from the year 304 AD describe traders in Chinese markets selling ants, for people to release into citrus orchards for pest control. In the late 19th century, predatory mites were introduced from the USA to Europe to try and control phylloxera attacking French vineyards, while ladybirds were brought to the USA from Australia to control scale insects on citrus trees. These early attempts were haphazard in their nature and over the last 70 years, biological control has developed into a highly regulated and much

more precise science. Relatively few examples of biological control have been practised in the UK, but interestingly, those that have are frequently targeted towards problems in the amenity sector, involving insect pests or invasive weeds.

There are three main types of biological control – conservation, inundative release and classical. Here I will describe each and give examples of their use in amenity areas.

Conservation biological control

This involves the conservation and enhancement of existing natural enemy populations, usually through habitat management. Excellent examples include the establishment of 'beetle banks' on farmland – raised areas at the edges or in the middle of fields that harbour populations of predatory ground beetles, called carabids. By planting the right combinations of plants in the bank, the insect populations that develop provide food for the developing carabids, which then move into the adjacent crop. There they provide good control of insect pests, and also slugs and snails.

At Royal Holloway, we applied this idea to investigate whether carabids could be used as biological control agents of insect pests such as leatherjackets and chafer grubs on golf courses. Carabids like to live in heather patches, so these areas can become the beetle banks on courses. In a three-year survey, we found that the beetles don't disperse very far, 80% of them moved less than 5m. So the distribution of heather patches and the inter-patch distances on a course become critical for the maintenance of the beetle population.

There were remarkable differences between courses in how heather patches are distributed (Fig. 1). In course A, most patches were less than 5m apart, while in the other, none were (indicated by the arrows). Thus, beetles would have no trouble moving around A, their populations were higher and they would be more effective control agents. Meanwhile, we were able to recommend to course B that they consider planting more heather or allowing existing patches to expand. This represents a cheap and easy method of pest control through habitat management.

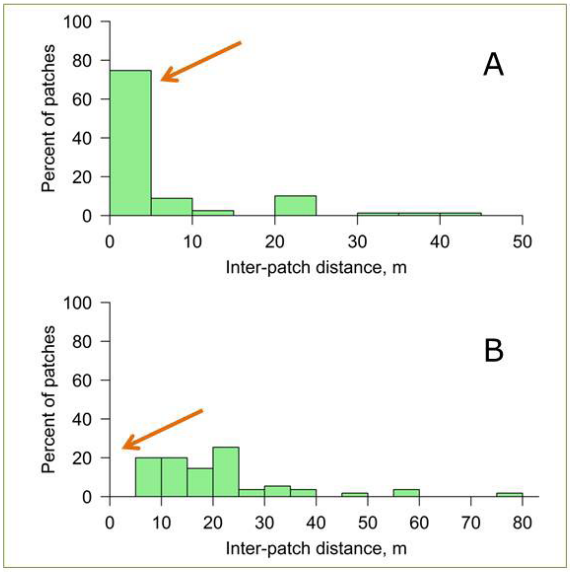

Figure 1

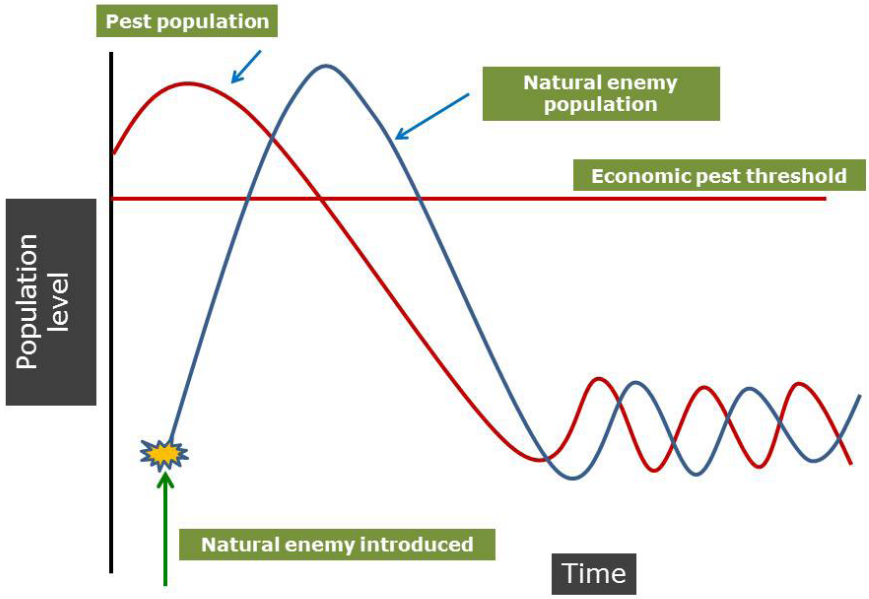

Figure 2

Inundative biological control

Here, a control agent is mass produced and then released periodically into an environment. In the amenity sector, an excellent example concerns the application of entomopathogenic (insect-killing) nematodes to turf to control chafer grub and leatherjacket larvae. Many products exist containing such nematodes, but they can be hindered by variation in soil temperatures, pH, moisture and chemical residues. They can be most effective in glasshouses where soil conditions are relatively constant and temperatures high, and control of vine weevils in ornamental crops is often very effective using this method. Recent innovations in nematode products for turf grass involve the use of three species in one formulation. The three nematodes have different tolerances to environmental conditions and different ways of hunting their host larvae. This makes the product much more effective compared to single species inoculants.

Another successful inundative example is the release of a weevil *(Stenopalmus rufinasus)* to control

"Many people think that the world uses too much pesticide."

floating fairy fern *(Azolla)* in British ponds and rivers. The Environment Agency, the National Trust, and many councils and river trusts buy and release weevils each year to keep waterways free of this weed.

Classical biological control

The vast majority of classical biocontrol attempts involve targeting an introduced pest or weed (often an invasive species). Here, one visits the country of origin of the target, to identify natural enemies (agents) that appear to regulate the population. After a detailed regulatory process, the agent is brought to the UK and a long period of host range testing is performed. This may take up to 10 y, and if it is absolutely clear that the agent will only attack the target, then one can apply for permission to release the agent into the area where the target is a problem.

If the agent is successful, then one will see a demise in the target population, as illustrated in Fig. 2. It is important to realise that, unlike chemical pesticides, biological control is not designed to eradicate a pest, but to get to a sustainable population cycle of target and agent, where the target causes minimal damage to the environment.

Two invasive weeds that are important in the amenity sector have been the targets of classical biological control recently. A sap-sucking psyllid (a type of bug, similar to aphids) was introduced by researchers at CABI Bioscience against Japanese knotweed in 2010. The psyllid has established and overwintered successfully but has shown only limited effects, due to it being in turn predated by native predators and parasites.

Meanwhile, in 2014 a pathogenic 'rust' fungus was released for the control of Himalayan Balsam. The efficacy has also been patchy, and research at Royal Holloway and CABI (who released the rust) has found that balsam populations vary genetically, depending on where in the Himalayas the original seed came from. Some races are more rust resistant, and this is exacerbated by other fungi (called endophytes) that reside inside the leaves and provide a natural defence system for the plant. Using such knowledge will help us to improve the efficacy of the rust in future.

Things that are not biological control agents

Biological control works by the agent eating and killing some of the target individuals. Certain beneficial organisms are sometimes termed 'biological control agents' and it is important to understand that while these may reduce growth or vitality of a target, they don't kill it. Thus, plant-growth-promoting rhizobacteria, arbuscular mycorrhizal fungi or endophyte fungi reduce insect growth, but they don't kill the insects directly. Applications of seaweed can reduce root-feeding nematode activity, but the nematodes are not killed. None of these are true biological control agents.

Conclusions

Biological control is not a quick fix; it does not seek to eradicate a pest or weed. But, it can be very cost-effective in the long term, and is a more sustainable solution than chemicals, with far less chance of resistance arising. But there will always be an element of bad luck involved – the agent may be affected by adverse weather, indigenous natural enemies or the natural defence system of the target. Will it ever replace chemical control? Not in our lifetimes, I suspect, but we can hope that the future is one of Integrated Pest Management, in which biological control agents work alongside reduced inputs of chemicals, to provide cheaper, more environmentally sound and sustainable methods of pest, disease and weed control in the sector.

Acknowledgements

I would like to thank the R & A for funding our heathland research on golf courses and the Natural Environment Research Council for funding our work on Himalayan balsam.

Further information on Azolla, knotweed and balsam control can be found at https://www.azollacontrol.com/ and https://www.cabi.org/

Figure legends

Figure 1: Bar charts illustrating how heather patches are distributed on two golf courses. Course A has a lot of patches close together, making it ideal for ground dwelling beetle dispersal. Course B has no such patches, thus some simple re-design of the course is recommended by expanding patch areas.

Figure 2: Hypothetical graph showing the idea behind classical biological control. When the agent is released, the pest population (red curve) is above the level causing economic damage. As the agent attacks the target, so the population of the latter begins to fall. Later, as the agent runs out of food, its population (blue curve) will also decline. Both end up in a stable series of cycles, but the key point is that neither go extinct and the target population is kept below the damage threshold.

GENOME EDITING – THE ERA OF PRECISION PLANT BREEDING.

Dr Penny Hundleby
Senior Scientist at the John Innes Centre in Norwich

In Oct 2020 two female scientists, Emmanuelle Charpentier and Jennifer Doudna, were awarded the Nobel prize for chemistry for their pioneering CRISPR genome-editing technology (first published in 2012).

This technology is set to rapidly move plant breeding into the era of precision breeding.

In short CRISPR allows scientist to make very precise changes to a plants existing DNA, resulting in an end product that would be indistinguishable from one achieved by traditional plant breeding, but delivered much faster.

Historically the launch of a new variety, using traditional breeding practices, can be decades in the making.

What makes things harder is that breeding programmes also need to be focused 10-20yrs ahead, looking at the anticipated needs of farmers, consumers and the environment. A faster and more knowledgeable breeding approach therefore offer great potential in addressing and meeting future needs.

Dr Penny Hundleby, a Senior Scientist at the John Innes Centre in Norwich, is passionate about the importance of plant breeding in reaching some of the sectors goals, such as the need to mitigate against climate change, improve sustainability and environmental practices, as well as the continued development of visually desirable and functional products.

The agricultural sector has always led the way in new technologies, and this is certainly true in the case of genome editing.

Penny's talk set the scene by taking us through the journey of plant breeding. From the tradition approaches most of us will be familiar with, involving the crossing of two parent plants to introduce new genetic variation (or desirable traits); to mutation breeding developed in the 1930s.

Mutation breeding was introduced to speed up the availability of genetic variation, it involves the exposure of seeds to chemical or radiation treatment to induce changes to the plant's DNA. This exposure can result in hundreds or thousands of random breaks in the plants DNA, which the cell will then attempt to repair.

During the repair process errors can occur; the base that make up an individual's genome sequence (represented by the letters A, C, T or Gs) may be deleted, or the wrong bases recruited during the repair, resulting in mutations (or changes) to the original genetic sequence. Plant breeders hope that some of these changes, the induced genetic variation, will result in desirable new traits.

Some applications of Genome Editing can be considered the upgrade to traditional mutation breeding.

However, rather than the random sledgehammer approach of chemical or radiation induced mutations – where you 'hope' you will create a desirable mutation -our knowledge of genomics and access to genome sequences mean we can now precisely identify and target the gene sequence we want to create a change in.

Unlike traditional mutagenesis, that introduces 1,000s mutations that require decades of breeding to then remove the unwanted changes, genome editing makes targeted and precise changes to the DNA.

The first agricultural products are now reaching the market, which is testimony to the speed at which these technologies are being adopted.

In Penny's talk she discussed several areas genome editing could potentially impact the amenity sector, such as slower growing turfgrass, plants with increased drought tolerance, disease resistance, or altered flower colour and shape.

However, she was also honest enough to say that the technology is unlikely to be enjoyed by the amenity sector any time soon, especially in Europe.

This is because the EU currently views all classes of Genome Editing to be GMOs. This viewpoint is currently being debated in Europe, for those products edited without the introduction of new DNA i.e. when used to make small changes to a plants own DNA, resulting in an end product indistinguishable to one made via traditional approaches.

In countries like the US, such products are not considered GMOs and would follow the same oversight and field assessments as traditionally developed plants. The EU is currently reviewing its stand here, and it is yet to be seen if the UK will follow the same path or if it chooses to go a different route. A public consultation exercise on Genome Editing has recently been launched by Defra in the UK, so it's a technology very much in the spotlight.

However, for now, that slow growing, lush green, shade loving, drought tolerant turf grass may well be seen in the US first.

The 15 min talk, recorded during lockdown, can be viewed here. ***https://www.youtube.com/watch?v=TW2u_OKw-xg&feature=youtu.be***

Dr Penny Hundleby is a Senior Scientist at the John Innes Centre in Norwich, UK. She is responsible for running and developing the Brassica Crop Transformation resources at the JIC and supports researchers around the globe. She uses Genome Editing technology as a research tool to gain a better understanding of the function of genes. She is an Honorary Lecturer at the University of East Anglia, Chartered Scientist and recently appointed to the board of directors for the International Society for Plant Molecular Farming. She has a strong interest in the biosafety and regulatory oversight of biotech crops.

INNOVATION IN PRACTICE

Ian Graham,
Complete Weed Control

How much thought does the average onlooker give to our operations when they see a boom sprayer on a golf course or a person with his knapsack spraying footpaths in their local park? It would be forgivable for them to assume that the process of applying plant protection products and the products themselves have changed little over the years; however, this is patently not the case. Not only has the political and environmental background relating to herbicide usage shifted considerably, but also the technology that is at our disposal. These changes have brought with them a much clearer responsibility with regard to how we operate, as well as an opportunity to be more precise and effective.

The skills of those that are able to do their spraying job to the highest standards are not inconsiderable. Achieving accurate application from a knapsack requires the operator to be able to maintain and calibrate their sprayer, whilst constantly assessing weather conditions and all the other variables that influence results. Similarly, a boom sprayer in the hands of an experienced operator is a marvel to appreciate, judging speed and position to traverse a fairway whilst dancing around all of the obstacles to produce beautifully even application. It is actually quite remarkable that we are able to take such small quantities of active ingredients and distribute them so evenly over such large areas in order for them to do their job.

Herbicides themselves have become more effective too through a greater understanding of the variables that impact efficacy. Water volumes and quality, as well as advances with surfactant technology, play a considerable part in improving results, as does nozzle selection and equipment choice.

Customers and consumers too have evolved in terms of their expectations, a look at some older footage of sports surfaces remind us of how remarkable our current standards are. Gone are the goalmouths that were mud baths devoid of grass, now we see pristine turf from the start to the end of the season. Equally the public's tolerance for weeds in our built environment has changed, we have become used to pristine towns and cities and the expectation levels are as high as the complaints are fast when the weeds establish themselves.

Innovation has been present in our industry for many years; in 1997 the Weed-IT technology, that has been so successfully employed to automate spot application, came to the market. With over 100 of these machines in use to accurately spot spray weeds on the nation's pavements, the reduction in herbicide consumed over the years is estimated to be well in excess of half a million litres. Given that for some time the glyphosate label has dictated that the product must not be blanket sprayed, this form of technology has to remain as a key tool in avoiding excessive use of one of our most important herbicides.

GPS sprayers are bringing similarly impressive change to the process of application to turf. Again, we see considerable economies as individual nozzles activate to ensure that there are no overlaps or missed areas even in the most complex and irregular target areas.

As an industry that is much more visible and more rigorously scrutinised than previously, the importance of standards has never been greater. The Amenity Standard that many of the best companies sign up to provides a very clear vision of what constitutes responsible and sustainable operation. Well qualified operators using modern equipment that are delivering a well- considered and sustainable solution to a problem are now the order of the day.