ANALYSIS

Is direct injection spraying technology about to take off?

Direct injection spraying systems have been around for years, but never really gained much popularity. *Future Farming* finds out why and asks if it might be about gain traction as farmers shift to a more high-tech approach to pesticide application to cut cost and environmental impact

BY ADAM CLARKE

gricultural engineers have come up with all sorts of innovative solutions to farmers' problems over the years. Some hit the big time and are seen on farms the world over, while others flop and end up banished to the back of the shed to gather dust.

Then there are those in between technology that lingers in the background, finding a handful of niche uses and limited adoption by hardcore enthusiasts.

Direct injection systems for sprayers fit into the latter category, having been around since the early 1980s, but never truly taken off.

However, agronomic and environmental concerns, combined with a drive to cut costs, could be about to trigger a slight resurgence in the technology, although some significant barriers need to be overcome first.

Simple concept

So, what is direct injection? The concept is simple and makes perfect sense: you have a "carrier" tank - typically water - and one or more chemical tanks.

Each chemical tank has a pump that injects neat pesticide at the desired rate into the carrier in a pressurised spray line before reaching the nozzles.

In principle, direct injection systems have several advantages, the first being a simple rinsing process.

The chemical flow is switched off and clean water runs through the contaminated lines to clear them out, leaving the operator with a clean slate for the next crop.

There are no washings to dispose of and it reduces overall residue build-up in the system, cutting the risk of compromising crop safety.

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This is particularly appealing on freshproduce units where a high number of crops can be planted sequentially or in small plots, requiring operators to frequently switch products or mixes.

With a direct injection system on board, this can be done from the cab with a flick of a switch and systems on the market today can carry five or six products at once, offering a high degree of flexibility and significant time savings to boot.

In addition, no measuring of product is required, so once the desired chemicals are on board, operators may only need to top up the main tank with water over the course of the working day.

Direct injection systems save money and offer environmental benefits, too.

Operators can use application maps to spot spray products just where they are needed for a specific weed, pest or disease problem, cutting overall pesticide use and the farm's chemical bill.

Some would also argue that while transporting a laden sprayer on the road, if an accident were to happen, a small spillage of concentrated pesticide is easier to contain than thousands of litres of tank mix running down the road

These are all admirable advantages and begs the question, why aren't there more direct injection systems in use?

Hiah cost

The first drawback is cost. John Deere offers the market-leading Raven Sidekick Pro system as a dealer-fitted option on its Des Moines, USbuilt self-propelled machines.

The firm quoted Future Farming a price of \$58,000 for a four-pump system, equating to between 15-25% of the price of the sprayer itself and a hefty investment by anyone's standards.

Second, despite the concept being simple, direct injection systems - which are mostly retrofitted - place a heap more complexity on a sprayer, its operator and the service dealer, which often don't have the expertise to offer the best after-sales support.

This has, in some cases, led to reliability issues and reduced trust in the concept, leading to a history of farmers who have tried, failed and ultimately ditched direct injection.

Variable products

Makers of direct injection kits have also struggled with product variation. Liquid pesticide formulations come in a huge range of viscosities and levels of abrasiveness, so have the potential to compromise reliability and accuracy of application.

It has also been difficult to find a solution that accurately meters dry formulations, such as wettable granules or powders.

Perhaps the biggest problem, however, is operator exposure - something that is under the spotlight and regulators are trying to eliminate where possible.

With direct injection systems, there is a need to pour neat chemical into holding tanks and if emergency maintenance of injection lines is required, exposure can be increased further.

Finally, there are still all the containers that need rinsing and the injection system will need flushing from time to time, so you still have plenty of contaminated waste to deal with.

So, with both pros and cons to direct injection, what lies in store for the technology?

Increasing demand

Demand is growing in North America. It is driven by weed resistance problems in GM Roundup Ready crops, with growers looking to spot spray different herbicides to help control tough-to-kill weeds.

Danish sprayer manufacturer Danfoil also



WHAT ARE THE OPTIONS?

Teejet Aeros: Like Raven, US spraying technology firm Teejet offer a retrofit system

reported a small rise in demand for direct injection technology in the past three years across Europe, particularly in Germany.

This could be down to some of the flaws attributed to the system being addressed, with companies such as French start-up Diimotion leading the way.

Its PiiX direct injection system has a unique patented dosing unit that claims to have higher accuracy (about 1% variation) than dosing pumps (about 5%) used on more established systems.

It also maintains this accuracy regardless of liquid formulation, aided by pressurising its chemical tanks to 0.5bar (7psi), and they have even developed a way to accurately meter and inject powders to within 5% accuracy.

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Raven Sidekick Pro: The global market leader in direct injection systems. Some our-pump system for a US-built John Deere machine retails at US\$58,000. **Danfoil Multidose 2000:** Danish sprayer manufacturer Danfoil offers sprayers

DiiMotion PiiX: French start-up DiiMotion's PiiX system can be bolted on to any sprayer for \$21,000-\$26,000 depending on specification. The firm will also be

Variable rate

In addition, the firm is working on a new valve that will enable real-time variable-rate application on wide booms.

It is hoped this will allow the use of sensors to recognise weeds and disease and automatically apply the right spray for the job, exactly where it is needed.

So far, its system has only operated in vineyards or horticultural systems, but CEO Xavier Cassassolles believes the PiiX's biggest market will be on broadacre-crop farms looking to vary rates to save chemical.

Similarly, Danfoil is involved in a \$2.9m project, run by the Danish government, universities and industry, which is building up a huge digital image database of weeds at

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all growth stages in different conditions.

It is hoped sensing drones can then be used to scan fields ahead of a sprayer fitted with direct injection technology, spot spraying or varying dose according to weed spectrum and levels on the move.

Variable-rate fertiliser and seed is already the norm on many farms, so it seems translating this into pesticide application is where we will see the real growth for direct injection systems – helping cut costs and use pesticides more judiciously.

Game changer

However, there is a sense any game changer for the concept rests with the big sprayer and agrochemical manufacturers.

Sprayer manufacturers need to see demand

increase before it becomes worthwhile to offer in-house systems for established sprayer models – which is key to gaining widespread trust in the technology among farmers.

Agrochemical manufacturers need to come up with a standard packaging solution that incorporates reusable closed-transfer technology to eliminate operator exposure and contaminated waste at farm level.

A fully integrated approach between agchem and applicator makers has already made direct injection standard for in-furrow applications on potato planters, with products such as Amistar delivered in a returnable 20-litre closed-transfer "Link-Pak".

Once this concept is transferred over to large boom sprayers, perhaps direct injection will be the next technology to hit the big time.

Direct injection systems

Pros

- ✓ Water and chemicals kept separately
- No washings generated between jobs
- ✓ No residue build-up in main tank or spray lines
- Select from multiple products at the flick of a switch
- Enables spot and variable-rate spraying to reduce pesticide use

Cons

- K High cost and complexity of retrofit systems
- Lack of adequate after-sales support
 Problems with variation in chemical
- formulations
- Container and injection system rinsing generates contaminated waste
 Lack of standard packaging with closed-transfer capability to reduce operator exposure

The path ahead

- Agrochemical manufacturers need to agree on packaging solution
- ► Major sprayer manufacturers must integrate closed transfer into designs
- Push for variable-rate pesticide application will drive demand

