How Sprayers are Changing Through Innovations in Agriculture

Parker

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Introduction

Research from the European Commission has shown that the estimated value of agricultural output in 2022 rose sharply in nominal terms (+19.2 %). This represented a new peak and continued the upward trend that had started in 2010[1]. This ongoing growth is attributed to evolving technologies and chemicals combined with advanced farming strategies.

Of these technologies, the humble sprayer is one of the most important to the growth of the industry. Both used to nurture crops with water and fertiliser and control harmful pests and weeds, sprayers directly impact crop yields and the quality of crops that are produced. This white paper will show the challenges and trends that are currently impacting sprayer designs, as well as the new and exciting opportunities that farmers and OEMs alike can capitalise on for superior sprayer performance.

Challenges

No industry or piece of equipment is without its challenges. When it comes to sprayers, there are multiple challenges that must be overcome, lest the growth that the industry is experiencing starts to decline.

Leakage and corrosion

Leakage and corrosion create one of the biggest challenges facing the farming industry. Leakage, which is heavily caused by corrosion, leads to lower fuel efficiencies, mechanical issues with equipment and crop contamination as caustic fluids leak out into the soil. That's why agricultural equipment is expected to have absolutely zero leakage.

The reason that this is especially an issue for sprayers is due to the caustic chemical environments that they operate in. Nitrogen-based fertilisers, salt sprays and other aggressive chemicals can cause standard hoses and tube fittings to become severely corroded, in as little as 14 days in more aggressive environments[2]. This puts sprayer assemblies at an increased risk of early failure, causing unplanned and costly equipment downtime.

Spray drift

When spraying pesticides, particles can drift away from the intended target area, potentially contaminating other crops or patches of soil. This is known as spray drift[3], and it's a big issue for sprayers. Not only can spray drift damage non-target areas, but it can also lessen how effective the pesticides are on the intended application area, which drives up costs as more chemicals are needed.

There are two main types of spray drift: physical droplet drift and vapour drift. Physical droplet drift refers to pesticide's initial liquid particles as they move away from the intended application area.

Droplet size is the most important factor here, as smaller droplets are more susceptible to air movement. Vapour drift, on the other hand, can happen when the chemicals in a pesticide vapourise after being applied to the target zone, creating a gas that can easily be carried by the wind.

Stressed weeds

While it may seem a bit counterintuitive, healthy, actively growing weeds are easier to control and kill with herbicides than stressed weeds[4]. When a weed is stressed, it becomes more resilient to herbicides, allowing it to survive herbicide formulations and rates that would have normally killed it had it been healthy. Stress can occur for a number of reasons, including:

- Lack of moisture
- Extreme weather conditions and temperatures
- Waterlogging and lack of oxygen
- Nutrient deficiencies
- Tillage or slashing from farm equipment.

What makes this issue even worse is that weeds can be stressed without having any visual cues. Especially if there has been sufficient rainfall, a weed may appear vibrant and healthy. This can happen to whole fields of weeds or individual ones, meaning that what worked on one weed may not work on the one next to it.

Drought conditions and the resulting moisture issue are the leading cause of weed stress. When a weed is moisture-stressed, translocations and respiration can severely slow down, making it much harder for herbicides to move through the weed and get where they need to go. Impaired metabolic processes within the weed can also slow the breakdown of the herbicide, which can damage the crop or pasture.

Some herbicides even can enhance the performance of others.

Improper herbicide mixing

Sprayer tank mixing can help minimise costs and reduce the need for multiple pieces of equipment. Some herbicides even can enhance the performance of others, offering improved weed control than if the herbicides were used on their own[5].

However, some herbicides are incompatible with each other and cannot be tank-mixed. If these chemicals are put together, it can cause crop damage and lead to reduced weed control. Even if herbicides are not intentionally mixed, there is a chance of cross-contamination when traces of a herbicide are left in a sprayer after treating a previous crop[6]. With how exact these formulas need to be, it's no surprise that even just a bit of leftover product at the bottom of the tank or in a hose can ruin the next batch of herbicides – or worse – the crops they're used on.

Ground compaction

While less directly related to sprayers, ground compaction is one of the biggest challenges in the agriculture industry[7]. Any piece of heavy equipment that moves over a field will compact the soil below it. Ground compaction changes the quality of the soil, making it a challenge to plant seeds properly. By compressing the soil and reducing pore space, this makes it harder for the soil to get adequate amounts of water, which impairs crop emergence, root penetration and crop nutrient uptake.

These effects directly impact crop yields since it becomes more difficult for plants to grow and reach full maturation. This will only get worse the more a sprayer weighs, as heavier pieces of equipment will lead to greater ground compaction. It's also an issue if the weight of a machine changes as it moves through a field. Sprayers will get lighter and lighter as they dispense fluid, meaning that a sprayer will compact the ground more with a full tank than it will right before needing a refill. Varying levels of compaction make it difficult to plant crops, especially with manual downforce solutions.

Trends

Fortunately for farmers and OEMs alike, there are a number of growing trends in the agricultural industry to help combat these challenges. From increasing a sprayer's performance and efficiency, to lowering costs and easing the burden put on the end user, the following trends seek to improve upon the design and use of sprayers.

Precision spraying

Precision agriculture is a prominent trend for the farming industry as a whole. Making sure that machines have both the power and tact to be able to operate in a very accurate, controlled manner is imperative to achieving better equipment performance and higher crop yields. For sprayers, this mainly manifests in what's known as precision spraying[8].

Precision spraying is all about being able to spray the right amount of herbicide, pesticide or fertiliser over a crop or pasture. Under- or over-using these sprays (or using the wrong one) can lead to a plethora of issues, including underdeveloped crops, overgrowth weeds and infertile soil, just to name a few.

By using advanced sensors, sprayers will be able to identify the type of weed or invasive insect affecting a crop so that farmers can use the best herbicide or pesticide, and in the right amounts. Sensors can also help on the fertiliser end by scanning an area and showing the best place to spray the fertiliser in order to optimise soil and crop absorption.

Weed mapping

It's simple – weeds are bad for crops. Having uncontrolled weeds in a field can lead to decreased crop yields, no matter how bad the weeds look based on a visual inspection. In fact, if your weeds have already gotten so bad that they are a visual eyesore, then it's probably already too late for your crops.

Weed mapping[9] is all about identifying where weeds are in a field so that they can be dealt with accordingly. Trying to find where weeds are is nothing new, but farmers are not seeing that regular monitoring is required to control their growth. Using aerial imagery from unmanned aerial vehicles (UAVs), farmers can view their entire fields from the top-down level and target specific locations with the required herbicides. This is crucial since applying the amount of herbicide to an entire field creates waste, pollutes the environment and cost farmers more money at the very least, with crop damage and lower yields a strong likelihood.

Equipment downsizing

If it gets the same job done, a smaller, lighter piece of equipment is almost always more efficient and cost-effective than a larger machine. With a sprayer's weight affecting everything from soil compaction to its fuel economy, smaller and lighter sprayer components are becoming more and more appealing to anyone involved with these machines.

Opportunities

There are multiple technologies and strategies that OEMs and farmers alike can use to drive growth in the sprayer space.

Corrosion-resistant coatings

With the extreme conditions in which sprayers operate, solving the issue of corrosion is at the top of the priority list. Since the environment or the chemicals that these machines are subject to cannot be changed, mitigating corrosion is best accomplished by covering a sprayer's components with a protective coating.

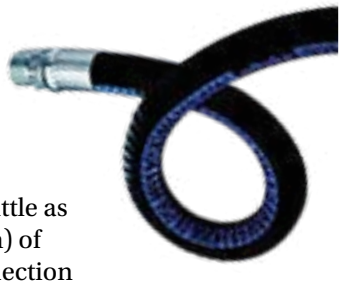
This is where Parker's XTR (Extreme-Resistance) coating comes in. Designed for agricultural equipment that operates in highly caustic environments, Parker's XTR coating provides unprecedented corrosion resistance for any components of a sprayer that are prone to corrosion and leakage. Steel fittings and adapters with the XTR coating can withstand corrosion more than seven times longer than the SAE standard of 96 hours. In fact, Parker's proprietary formulation resists corrosion for more than 720 hours when tested in accordance with ASTM B117. Compliant with environmental regulations such as RoHS, ELV and REACH, Parker's XTR coating assures leak-free performance in even the harshest applications.

Hose assemblies

The mechanisation of agriculture has been a key growth driver in the hose and fitting market. Farmers rely on increasingly efficient equipment that equate to lower cost per crop tonne or lower cost per hour of operation. Though OEMs have different growth strategies, the challenges are similar: growing competition, evolving customer demands, and shifting hose and fitting geographic markets. Specific applications require specific hoses.

Globally available product or high impulse life are two examples. Bend radius is particularly important in tight spaces. Hose weight is critical due its impact on transportation costs, fuel economy and ease of installation. Parker's GlobalCore high-performance cohesive hose and fitting system meets these needs.[10] It was designed, built, and tested to the ISO 18752 specification. It simplifies specification for OEMs and end users by providing a complete family of products for the most commonly used constant working pressure classes.

In cases, where a made-to-order preformed hose is too costly, an E-Z Form hose for coolant, water and oil suction/return lines should be considered. Designed to handle extreme bends while allowing full-flow, kink-free performance, it effectively replaces pre-formed hoses— eliminating special design, tooling, and fabrication costs.



Conversely, formed hoses continue to be beneficial though. They can save, space, time and eliminate misalignment issues. As little as 1/8" (approximately 3mm) of misalignment to the connection can create enough issues to potentially shut down equipment. They also eliminate the need for additional fittings/adapters, significantly reducing equipment weight. Parker's formed thermoplastic hoses, such as the TOUGHJACKET product range, for applications requiring up to 6000 psi and an O.D. of -2 to -16, can be used in boom applications where they reduce boom bounce, allowing spray in a more precise pattern. They are also bondable, improving the management of the hose and increasing the overall strength of the assembly.

For sprayers, Parker's hydraulic and formed hoses offer innovative design, high performance, easy installation and extended hose life to enable farmers to meet the increased demand.

Efficient and reliable hydraulics

Parker offers a wide range of hydraulic pumps and motors to provide fluid flow in an efficient and reliable way. An optimized power to weight ratio and reduced energy losses improves farmers machine efficiency and contribute to a lower overall weight. With Gear Pumps & Motors, Torqmotors, Vane Pumps & Motors, Bent-Axis Pumps & Motors as well as Axial Piston Pumps Parker offers components for any solution and price level in high quality, short lead times and great service.

Parker Torqmotors[11] are ideally suited for tough jobs under tough conditions, offering high starting torque and trouble-free service. Used in Sprayers to support the spread, Torqmotors are the perfect choice for low speed rotation without the need of a drain line.

Advanced sensors and IoT-enabled technology

With the importance of precision agriculture to sprayers, consistent, real-time data (as well as long-term statistics) are required to ensure that sprayer functionalities are accurate and efficient. This can only be achieved through enhanced sensing technologies.

Pressure, temperature, and position sensors are just a few of the sensing technologies that can be incorporated into sprayer designs for IoT, safety, precision, and overall system integration. The complex mechanical, electronic and hydraulic systems used by mobile equipment, when supported by digital ecosystems, are ushering in a new era of mobile solutions innovation.[12]

These and other advanced sensors when integrated with an IoT system and mobile controller software, such as IQAN, enable OEMs and sprayer owners to collect actionable data to improve their operations. Parker's IQAN Software leverages easy-to-use tools reducing programming time for machine control systems, while delivering easy-to-use graphical programming where time to market and ease of development is key. It allows users with no programming experience quickly to write applications for the desired functionality of their machine. With graphical interface and predefined building blocks, OEMs can make control and connectivity easy for sprayer operators as well.

While fully automated sprayer fleets may seem far away, sprayers are already on the path to full autonomy. That is because smart sensors and better data are the building blocks of automation. Not only will automation reduce the amount of labour needed to oversee sprayer operations, but it will also make everything faster and more efficient.

Central tire inflation

In order to reduce ground compaction, consider the sprayer's wheels. Reducing tire pressure results in a bigger tire footprint, which lessens ground compaction. This can be achieved through the use of a central tire inflation systems which can also help increase traction, fuel economy and tire life, improving the overall sprayer performance. Parker's Central Tire Inflation System (CTIS) is ideally suited for use on a range of agricultural equipment including sprayers. Each wheel end is equipped with a CTIS wheel valve connecting the tire to the CTIS control system whenever it is actively measuring or changing tire pressure. Otherwise, the wheel valve is closed, isolating the tire from the system, thus ensuring that the tire will not leak. This eliminates the need for manually operated shut off valves when the vehicle is inactive for extended periods of time.

Parker's CTIS pneumatic control unit consists of electro-pneumatic valves and pressure sensors required to monitor and control the pneumatic system. This bigger footprint allows the sprayer to essentially float across the soft terrain instead of compacting the soil and creating ruts. The Parker CTIS can deflate tire pressures significantly lower than other systems while operating reliably over a wide range of temperatures and altitudes.[13]

Conclusion

There is a slew of challenges that must be overcome in the sprayer space, some proving to be bigger obstacles than others, but with the information presented in this white paper, sprayer OEMs and end users are primed to work past these issues and optimise their processes. With the opportunities available to sprayer designers, the future of sprayers will be all about capitalising on trends and new technologies in order to continue – if not exceed – the growth that is currently seen in the agricultural industry.

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