



**SPRAY APPLICATION MANUAL FOR GRAIN GROWERS**

**Module 23**

**Upgrading the sprayer**

Questions to ask before proceeding

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## Key points

- Before upgrading the sprayer, the operator should determine what changes to the equipment or their current practices will most increase productivity.
- Tank size and boom width will have the greatest impact on the productivity of the sprayer while it is in the paddock, however, improvements to the mixing and filling operations can also increase the overall productivity of spraying operations.
- Integrating the sprayer with other farm equipment will increase efficiencies over time and may improve efficacy where the level of precision is increased.
- Always compare the cost of upgrading current equipment to that of a new purchase.
- Where the purchase of another sprayer is required, fully consider the cost of owning and operating the machine against the potential costs of not making that purchase.



### Buying a Sprayer – a grower perspective

## 1. Introduction

Whether it is through the purchase of a new sprayer, or a major re-fit of an existing rig, the reason for upgrading the sprayer should be to improve productivity or to improve efficacy (or both) without negatively affecting either one of these.

The decision to make a new purchase, or to refurbish an existing sprayer, will depend on what the current and future needs of the farming system are, as well as how far the enterprise has progressed towards integrating all of the equipment. It is important to ensure that all of the farm equipment can work well together, particularly the tyre centres and total equipment widths, starting with the harvester and seeding equipment. This will increase efficiencies of all machinery over time.

In many situations, an upgrade to the existing sprayer or an upgrade to the mixing and handling systems will provide an increase in productivity while other farm equipment is being upgraded or replaced. As with all equipment, technology changes and the options available are increasing at a rapid rate, so it is important to define what you actually require the sprayer to be able to do, now and into the future, so you can critically evaluate the options available.

Each of the modules included in this GRDC GrowNotes™ *Spray application manual for grain growers* have been assembled to provide practical information to assist with the decision-making process when it comes time to upgrade the spraying equipment or to improve spraying operations.

The following section of this module provides a summary of some of the important things to consider before upgrading the sprayer or any of the major components.

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## 2. Start with the types of products to be used and how they need to be applied

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An important first step to determining what functions the sprayer will be required to perform is to look at what products and tank mixes are likely to be applied. It may be useful to discuss this with an agronomist or adviser so you can consider some of the potential changes to product types, labels or farming practices that are likely to occur.

When considering the products or tank mixes to be used, some of the important things to determine are:

- **the total application volumes that are likely to be required;**
- **the timing of applications, particularly where double-knock strategies for herbicides are required;**
- **the ability to batch or premix products, the required mixing order and decontamination procedures; and**
- **current and future label requirements, particularly for drift-reduction strategies and downwind buffer management, as they are included on more product labels.**

Preparing spray plans for various groups of products is a useful starting point to identify how the sprayer will need to be set up for various applications, including nozzle selection and rate controller set-up (see Figure 1 for an example).

Figure 1 Example of a completed spray plan.

## Spray plan part 1 ►

Sprayer details:	Self-propelled sprayer – auto height control					
Spray job and target:	Summer fallow – broadleaf and summer grasses					
Paddock name or ID:	River Block					
Situation	Standard label buffer			Modified buffer		
Product names and rate:		rate			rate	
	Group I herbicide	1.0 L/ha		Group I herbicide	1.0 L/ha	
	Glyphosate 450	1.5 L/ha		Glyphosate 450	1.5 L/ha	
				Low-drift adjuvant	0.2 L/100 L	
How do the products need to be applied according to label, adviser or Buffer Calculator?	Speed range (km/h)	16.0 – 24.0 km/h		Speed range (km/h)	14.0 – 20.0 km/h	
	Application volume (L/ha)	60 L/ha		Application volume (L/ha)	80 L/ha	
	Spray quality	Coarse (C)		Spray quality	Extra Coarse (XC)	
Is a label downwind buffer zone required?	Standard	XXX	(m)	Modified	YYY	(m)
APVMA Buffer Zone Calculator inputs	Nozzle height (m):	0.5M		Other:	Low-drift adjuvant added	
	Wind direction from:	120 degrees		Other:		
Number of nozzles used	72	Boom width (m)	36.6m	Nozzle spacing (m)	0.508m	= W

## Spray plan part 2 ►

<b>Steps to select nozzles and operating parameters:</b>							
1. Calculate required flow rate for the nozzles (L/minute/nozzle) = L/ha x speed km/h x width (m) ÷ 600							
2. Choose nozzle size, type and operating pressure to match label or buffer requirements and sprayer's ability							
3. Determine the minimum and maximum speed to run the selected nozzles (to operate effectively and maintain spray quality)							
4. Determine the L/min/nozzle at the minimum, constant and maximum pressures and calculate total flow through boom.							
Nozzles selected and operating parameters	Nozzles selected for each situation	Standard label buffer TeeJet® AIXR 110-025 VP			Modified buffer TeeJet® TTI 110-025 VP		
	Total application volume (L/ha)	60			80		
	Look into or calculate	Minimum	Constant	Maximum	Minimum	Constant	Maximum
	Pressure at nozzle (bar)	2.0	4.5	6.0	2.0	5.5	7.0
	Spray quality	XC	C	C	UC	XC	XC
	Spraying speed (km/h)	16.0	24.0	27.5	14.0	20.0	22.3
	L/minute/nozzle	0.81	1.22	1.40	0.95	1.35	1.51
	Total flow through boom (L/min)	58.32	87.84	100.8	68.40	97.20	108.72
<b>Comments</b> (e.g. sprayer type used, specific set-up, buffer calculation or sensitive area) A detailed farm map showing sensitive areas should be attached to this spray plan.							



► For more information on these topics refer to:

### Module 1: The need for planning



### Module 2: Product requirements



### Module 4: Drift-management strategies



### Module 5: Spray plans





### 3. Matching the sprayer to current and future farming practices

To establish what the ideal size of the sprayer should be, and the capabilities it must have, the operator should determine what the total area to be sprayed is and the timeframes that are typically available to complete each spraying operation. This should provide an indication of how many hectares per hour the sprayer needs to be able to cover to complete spray jobs in a timely manner.

The greatest increases in the productivity of the sprayer will come from having a larger tank and operating with a wider boom. While increasing spraying speed can also increase productivity this should be considered carefully as higher spraying speeds will increase the risk of off-target movement of products and potentially reduce efficacy.

Improving the mixing and transfer processes can also provide a major increase in productivity, which may help to extend the life of your current sprayer by reducing the overall engine hours.

#### Mobile mixing and transfer system



Reducing time out of the paddock by improving the mixing and filling process may extend the life of the current sprayer. ►

Source: Graham Betts

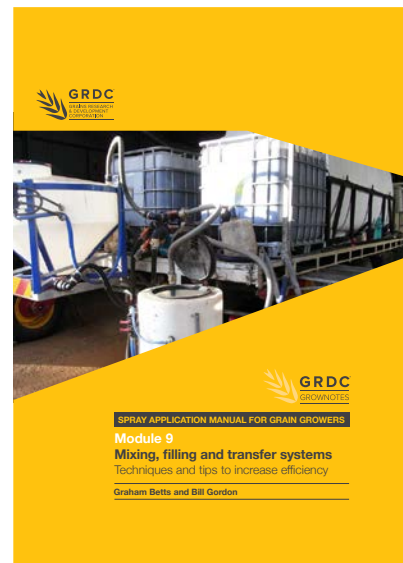


► For more information on these topics refer to:

### Module 4: Drift-management strategies



### Module 9: Mixing, filling and transfer systems



### Module 11: Pumps, plumbing and components





### 3.1 Integration of the sprayer with other equipment

Tyre centres and machinery widths will only increase efficiency to the level that the accuracy of the GPS and auto-steer functions will permit. The accuracy and repeatability of the GPS is critical to provide the opportunity for additional spraying techniques to be used, such as banded applications and inter-row shielded spraying.

#### Matching nozzle spacing to the crop row width



Before upgrading the sprayer, it is important to consider how well all of the farm equipment works together. Matching row widths and nozzle spacing allows for a greater number of application techniques. ►

Source: Graham Betts

Many options are now available, such as Networked Real Time Kinematic (accessing Global Navigation Satellite System and the continuously operation reference station network), allowing some operators to access more accurate GPS at relatively lower costs than traditional subscriptions to some GPS networks.

Where the GPS accuracy is 3 to 4 centimetres (or less), matching the tyre centres of all farm equipment will allow for improved row configurations, and may provide the ability to match the nozzle spacing to the crop row width for many enterprises.

It is also important to consider whether several of the sprayer's functions can be integrated into one central screen for ease of access to various functions, as well as what can physically be displayed while the machine is being operated.

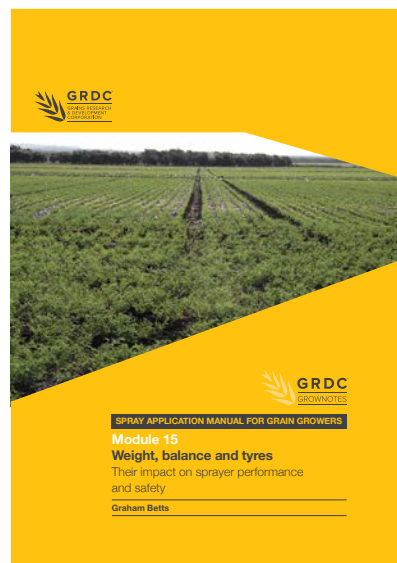


► For more information on these topics refer to:

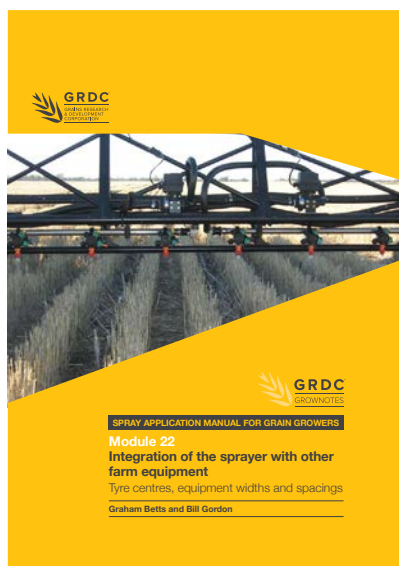
### Module 12: GPS systems



### Module 15: Weight, balance and tyres



### Module 22: Integration of the sprayer with other farm equipment



### Checking the weight and balance of a sprayer



Before any increase to the tank size or boom width, consider the impact on the weight of the sprayer and the tyres required. ►

Photo: Graham Betts



## 4. The choice of spraying system and supplier

Making a list of the features that are important for your operation is a useful place to start, as is making a list of the machinery dealers that provide excellent service in your area.

Often the service provided by the dealer is more important than the colour of the machine.

Important considerations should be:

- the range of spraying speeds and total application volumes required;
- the ability to maintain control of the spray quality and to easily change the spray quality when required;
- the ability to maintain boom height;
- matching the measurement system to the other equipment used (stick with all imperial units or all metric units); and
- the ease of operation, maintenance and decontamination.

### Norac auto height sensor fitted to a Miller sprayer



Having a stable boom with a good height-control system can increase the uniformity of spray applications and minimise spray drift. ►

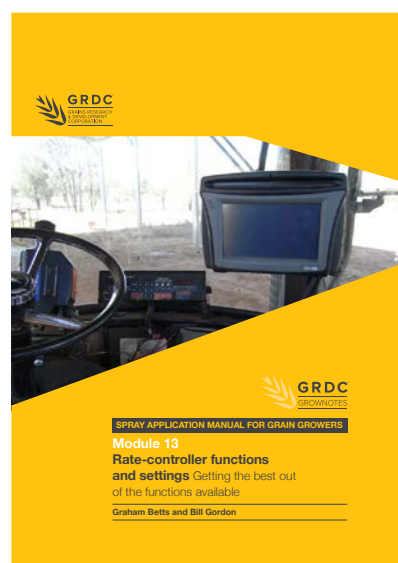
Photo: Graham Betts

► For more information on these topics refer to:

#### Module 5: Spray plans



#### Module 13: Rate-controller functions and settings

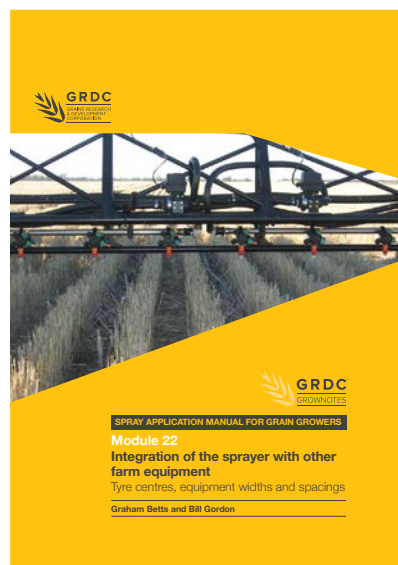




### Module 14: Boom stability and height control



### Module 22: Integration of the sprayer with other farm equipment



## 4. Comparing the options available now with what will be available in the future

The introduction of multi-step systems and 10-hertz pulse width modulation (PWM) have marked the beginning of a new generation of spraying systems.

Improvements, such as increased cycles per second (from 10Hz up to 30Hz), for PWM will mean that a wider range of nozzles can be operated, including air-induction types. New releases of multi-step systems, including multi-step PWM systems, which could mean the only time the operator has to change nozzles is when they are worn out, are also on the horizon.

Operators should pay close attention to what product releases are going to occur in the near future as this may help with making a decision about which spraying systems to consider and whether to buy now, upgrade, or wait for something that matches all of your needs.

Often, following social media and conducting regular searches of machinery manufacturers' websites will provide advanced information of what new spraying systems will soon be available.





► For more information on these topics refer to:

### Module 16: Overview of the spraying systems available



### Module 17: Pulse width modulation systems



### Module 18: Single line and multi-step systems



### An ARAG Selectron® multi-step spray system



The spraying systems available to the operator are continually evolving. Always prepare a list of what you require the sprayer to do before upgrading the sprayer. ►

Photo: Graham Betts

## 5. Useful features and components to consider when upgrading the sprayer

Regardless of the spraying system fitted to the machine, the pump, plumbing, filtration and valves will always remain critical to the operation of the sprayer.

Spending time to ensure that the pump selected has enough capacity to deliver sufficient flow to the nozzles and to thoroughly agitate the tank mix, and that the valves and other components will work well for all of the flow rates you will require, is essential. It is also important to ensure that the materials that each component is made of will be suitable for the tank mixes you intend applying.

Features, such as individual nozzle section control and boom recirculation systems, are set to become standard features on most sprayers. Turn compensation is also likely to become more common.

Whichever spraying system the operator chooses, it is important to consider the serviceability, calibration and decontamination of the system. The ability to isolate the main tank from the rest of the spray system should always be an essential feature of the sprayer, however this is sometimes overlooked by the manufacturers.

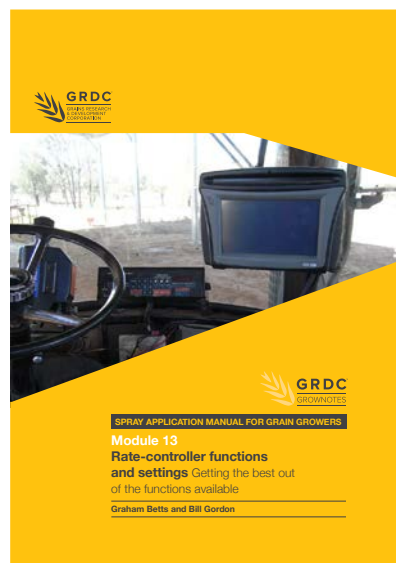


► For more information on these topics refer to:

### Module 11: Pumps, plumbing and components



### Module 13: Rate-controller functions and settings



### Module 14: Boom stability and height control



## 6. Nozzle selection

The choice of nozzles fitted to the sprayer is often a secondary thought after the decision about which sprayer (or spraying system to use) has been made.

Perhaps this approach should be reconsidered, by determining what volumes and spray qualities are required and which spraying system can best maintain the spray qualities you require, at the range of spraying speeds and application volumes you are likely to operate at.

The spraying system must be able to produce the flow and pressure at the nozzle for all of the sets of nozzles that are to be fitted to the machine. The nozzles are an important part of the whole equation. Matching the nozzles to the sprayer's capabilities and the operator's requirements will ensure that when the sprayer is delivered it is able to be used as intended.

### Multiple sets of nozzles ready to use



Nozzle selection is an integral part of any sprayer upgrade. Integrating the wheel centres of all equipment will increase efficiencies over time, and can increase the precision of spray applications.



Source: Bill Gordon

Often it is difficult to decide what the most appropriate nozzles should be when the operator has not established what spraying speeds will actually be used. For single line sprayers using a standard rate controller it is critical to determine what the average and minimum spraying speeds will be in a range of paddocks. Unless the operator has driven the sprayer under field conditions at their enterprise, this is almost impossible to know.

For multi-step systems or PWM systems, knowing the actual spraying speed may be less critical, provided the sets of nozzles supplied with the sprayer are able to deliver the required application volumes and spray qualities at a range of spraying

speeds and application volumes. The operator needs to supply the machinery dealer with information about what they expect the sprayer to be able to do, so the most appropriate sets of nozzles can be supplied with the machine.



► For more information on these topics refer to:

### Module 3: Nozzle design and function



### Module 5: Spray plans



### Module 17: Pulse width modulation systems



### Module 18: Single line and multi-step systems





## 7. Making a decision

It may seem obvious, but it is important to establish if you actually need a new sprayer before planning the purchase – it may be possible to refurbish an existing sprayer.

Unless there are major structural or mechanical issues with the sprayer, particularly when upgrading a trailing rig, it may be worth considering if various components can be replaced or improved to match the list of features you require.

### Wheel extensions on a John Deere tractor



Integrating the wheel centres of all equipment will increase efficiencies over time, and can increase the precision of spray applications.



Photo: Graham Betts

It is useful to determine if the chassis and suspension will support any of the following:

- a change to the tyre centres to match other equipment;
- an increase to the tank size to increase the area sprayed per load (carefully consider the impact on weight and balance, as well as the tyres required);
- if the boom is able to be extended or a new, wider boom can be fitted (will the current frame support a wider boom); and
- if the current boom centres will support an upgrade to the boom stability and height control systems, or if they can be modified to support these.

Always check whether the sprayer or tractor hydraulics and current sprayer's plumbing system can support the increased flow rates that will be required if larger tanks, wider booms, higher application volumes or higher spraying speeds are being considered.

Consider whether a major refurbishment of the pump, the plumbing system and the rate controller will provide increased functionality, such as improved section control or boom recirculation to reduce wastage and over-sprays.

If considering an upgrade, carefully compare the expected increase in hectares per hour of any change to the sprayer against the increase in hectares per hour of spraying that could be achieved if the mixing could be done in the paddock with improved mixing and transfer systems. Alternatively you may compare the cost of doing both against the cost of a new spray rig. Therefore when you do decide to replace the spray rig, you will still have the mixing and transfer systems in place to maximise the productivity of a new spray rig.

**A self-propelled Case sprayer fitted with the AIM Command® pulse width modulation system**



The decision to purchase a new sprayer should always take into account the service provided by the dealer. ►

Photo: Case



### Buying a Sprayer – part 2

#### Things to consider when the purchase of a new sprayer is required

Even for a new sprayer, it may be useful to establish which components or options available on the sprayer at purchase are able to be upgraded at some time in the future. Compare the costs of optional components or upgrades on delivery, versus the cost of retrofits at a later date.

Consider the ‘whole of life’ costs of the sprayer: how much will it cost to own and operate the sprayer? Carefully analyse the running and service costs of the sprayer model you are considering by gathering as much information as possible from other operators and the machinery dealers. Also consider what the residual value of the machine will be at the end of the time you plan to own it.

Documenting the maintenance and services conducted, along with minimising the engine hours by mixing and filling near the site of application, will help to retain the sprayer’s value at changeover.

As with any machinery, carefully consider the fixed and variable costs. It is a good idea to consult with your accountant regarding depreciation schedules and lease or finance options.

