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GROWNOTES

SPRAY APPLICATION MANUAL FOR GRAIN GROWERS

Module 14
Boom stability and height control
The importance of design and control

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Key points

- Maintaining the correct nozzle height is critical for obtaining a uniform spray pattern and minimising the potential for spray drift
- Auto height control has become a standard feature on many sprayers, however, their ability to function correctly will depend on the boom design, sprayer set-up and calibration of the sensors
- Boom centres play an important role in boom stability and the functioning of height-control systems
- Always consider what you require a boom to do, the type of terrain it will be operated in and the actual set-up, such as nozzle position and spacing, before purchase.

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Benefits of height control systems

1. Introduction

One of the most useful ways to increase the productivity of a sprayer is to use a wider boom. However, increasing productivity may come at the expense of efficacy if the nozzles cannot be maintained at the correct height above the target (or false target) to provide uniform coverage and minimise the potential for spray drift.

Too often spray operators need to raise the boom to stop the wings touching the ground, especially when spraying at higher speeds or on uneven surfaces, such as paddocks with depressions and contours.

Maintaining an appropriate boom height with wider booms often requires the addition of some form of height control, whether this is a manual system using touchdown wheels, an automatic system (hydraulic or electric hydraulic) using touchdown wheels, or an auto height system using sensors and hydraulic rams.

The ability of an auto height-control system to perform as intended will depend on the boom design, in particular the boom centre section.

This module outlines the importance of maintaining nozzle height, along with aspects the spray operator should consider about boom design to match their particular situation.

2. Importance of nozzle height

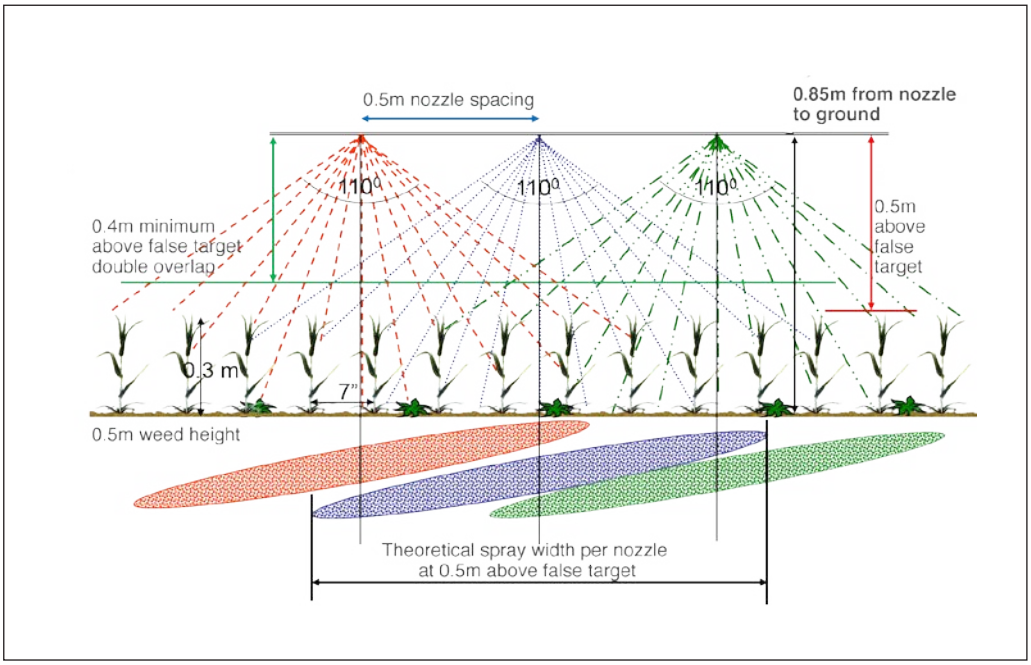
For broadacre boom spraying, the boom is normally fitted with nozzles that produce a tapered flat fan spray pattern and are designed to be operated with a double overlap of each spray pattern to achieve a uniform spray deposit across the width of the boom.

Tapered flat fan nozzles require a double overlap to achieve a uniform spray deposit.

The ideal height above the target (or false target, such as stubble or crop canopy) for nozzles with a tapered flat fan spray pattern is where the nozzles achieve a double overlap. The double overlap occurs when the outer edge of the spray pattern reaches the target directly below the adjacent nozzle on the boom (Figure 1).

As the angle of a nozzle's spray pattern reduces (for example, going from a 110° nozzle to an 80° nozzle), the height of the nozzle above the target or false target needs to increase to maintain the overlap.

Figure 1 The ideal height above the target or false target.

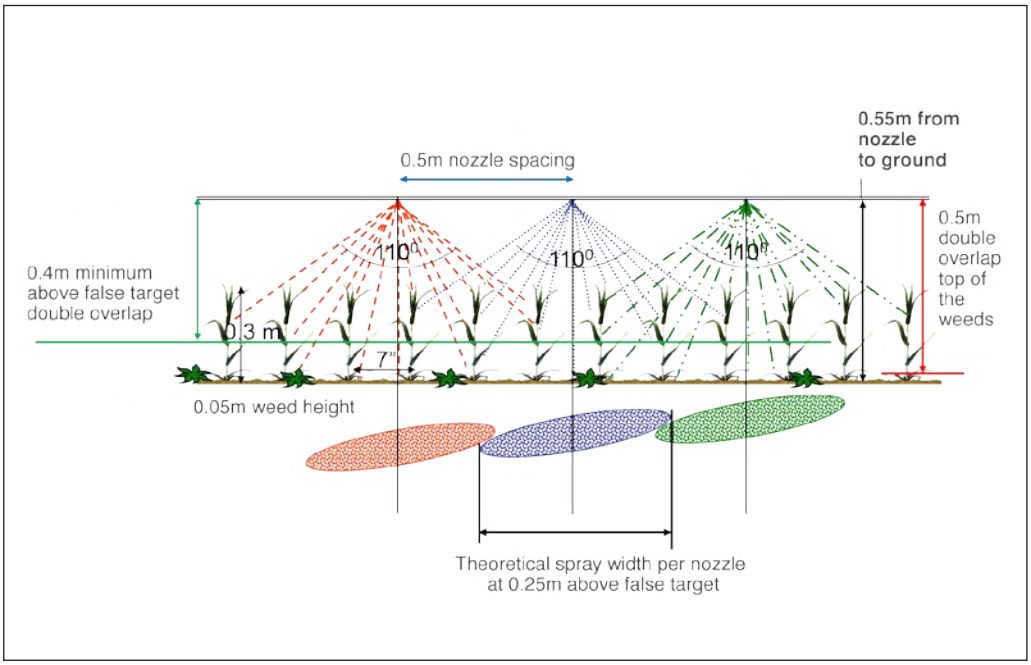


Double overlap is required for tapered nozzles to achieve uniform coverage.

Source: Graham Betts

Maintaining the boom height below the point where a double overlap of the nozzle spray patterns is achieved may result in variations in the application rate across the boom, potentially resulting in some targets being overdosed below the nozzles, while other targets between the nozzles may be under-dosed (Figure 2).

Figure 2 Wrong height above the target leading to uneven application.



The wrong nozzle height leads to over and under-dosing across the boom.

Source: Graham Betts

2.1 Establishing an appropriate nozzle height

To establish an appropriate height for the nozzles above the target or false target, the operator needs to know the angle of the nozzles' spray pattern and the nozzle spacing.

Once we have this information we can use Table 1 to look up the required height above the target or false target.

To achieve the double overlap, with the outer edge of the pattern reaching the target below the adjacent nozzle, for a 0.5 metre nozzle spacing, the width of the pattern from a single nozzle would need to be one metre wide to align with the adjacent nozzles.

To determine the height required for a 110° nozzle to achieve a sprayed width of one metre at the target, we could use Table 1 in the following way:

- **go down the left-hand column of Table 1 and find the 110° spray angle;**
- **follow the 110° line across until you find the closet figure to 1.0 metre, which is either 0.857m or 1.140m; then**
- **follow the 1.140m column up until you find the nozzle height above the target or false target, which is 0.4m.**

Table 1 The sprayed width of various nozzle angles at a range of heights above the target.

Nozzle spray angle	Nozzle height above the target or false target in metres							
	0.2m	0.3m	0.4m	0.5m	0.6m	0.7m	0.8m	0.9m
	Calculated spray width in metres (in theory) for the above nozzle heights							
40°	0.146m	0.218m	0.291m	0.364m	0.437m	0.510m	0.582m	0.655m
65°	0.255m	0.382m	0.510m	0.637m	0.765m	0.892m	1.020m	1.150m
80°	0.366m	0.444m	0.592m	0.740m	0.888m	1.040m	1.180m	1.330m
85°	0.367m	0.550m	0.733m	0.916m	1.100m	1.280m	1.470m	1.650m
95°	0.437m	0.655m	0.873m	1.090m	1.310m	1.530m	1.750m	1.960m
110°	0.571m	0.857m	1.140m	1.430m	1.710m	2.000m	2.290m	2.570m
120°	0.693m	0.857m	1.140m	1.430m	1.710m	2.000m	2.290m	2.570m
150°	1.490m	2.240m	2.990m					

The nozzle height above target or false target indicated in Table 1 (that is, 0.4m for a 110° nozzle) is a calculated or theoretical width only. Factors such as lower nozzle pressure, increased spraying speed and increased wind speed may cause the nozzle spray angle to be narrower.

After selecting the appropriate nozzle angle, the spray operator may still need to do a physical check to make sure the nozzle is at the optimum height above the target or false target.

Set the boom height at the determined height above the ground (pretend the ground is the target or false target) and have the nozzles operating at the intended spraying pressure. Stand upwind from the spray patterns, ideally with the sun shining on the spray pattern from behind.

The nozzle spray angle (spray pattern edges) should make contact with the ground directly below the adjacent nozzles. When this overlap occurs, the height above the target or false target for this particular nozzle at the intended operating pressure has been established.

Nozzle height above the target or false target may change when the nozzle pressure changes. For example, when spraying at slower speeds the nozzle spray angle could be narrower, which could give an uneven application rate across the boom. This may require the boom to be raised a little in some situations where spraying speeds are traditionally slower, such as headlands and around obstacles.

TIPS

- **Install a piece of hose on each wing of the boom between the last two nozzle bodies. Put a piece of tie wire up the hose and out through a hole down the hose to make it easier to attach the hose to the boom. Cut the hose to the required height above the target or false target. It is a good idea to use a piece of hose even when using automatic boom-height systems.**
- **If using half nozzle spacings (e.g. 0.25m) in combination with a multi-step nozzle system, and each step utilises different orifice size nozzles, the boom still needs to be operated at a height to match the single nozzle spacing (e.g. 0.50m). The boom can only be lowered if the same orifice size and spray angle nozzles are being used on all nozzle bodies.**
- **Adding target-selectable sprayer systems onto the boom can place added pressure on the boom stability.**

A piece of hose attached to the boom to indicate height

A visual guide on the boom makes it easy to set the correct nozzle height.

Photo: Graham Betts

2.2 The impact of nozzle height on spray-drift potential

Increasing the boom height may increase the potential for spray drift to occur. All nozzles produce small droplets that are capable of remaining in the air. Droplets that are less than about 200 microns in diameter will slow down quickly after leaving the nozzle, so increasing the boom height increases the likelihood of those small droplets remaining in the air, which increases the potential for spray drift to occur.

Increasing the boom height from 0.50m above the target to 0.70m can increase the amount of spray remaining airborne by up to four times, and at one metere above the target this can increase by a factor of 10.

For more information on droplet behaviour and spray drift management strategies, go to Module 4: Drift management strategies

3. Boom centre design and functions

There are a range of boom centres that are common to modern sprayers. These include rigid, pendulum, trapeze, inverted trapeze, and a combination of pendulum and trapeze.

3.1 Rigid or fixed boom centres

For standard boom spraying, fixed or rigid boom centres can have an impact on the boom height, and therefore the nozzle height, particularly when sprayer tyres go over uneven surfaces.

The stability and level of the boom will greatly depend on the chassis and suspension of the sprayer itself, which can make it hard to maintain the optimum nozzle height. Generally, rigid boom centres are better suited to sloping country than self-levelling booms.

Fixed centres may be useful if the operator is considering carrying extra weight on the boom, such as target-selectable units or shielded sprayers.

They are perhaps the best option for attaching some auto height-control systems, as this allows the boom wings to adjust without the centre trying to compensate. Auto boom height can help to maintain nozzle height because there is no compensating movement in the boom centre when the individual boom wings are raised or lowered automatically.

PLAY VIDEO

Boom stability – rigid boom centres

3.2 Self-levelling or pivoting boom centres

Self-levelling or pivoting boom centres are generally better suited to wider booms and for machines with less compensation in the suspension. There are several designs available that allow the centre section of the boom to pivot, which allows the boom to remain horizontal (to follow the horizon) as the chassis moves over uneven surfaces.

TIP
- If the sprayer has a well set-up boom centre the boom will want to follow the horizon (due to gravity), so it is very important that there is some way of locking up the boom centre while spraying sloping country and releasing the locking mechanism when spraying reasonably level country.

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Boom stability – pendulum booms

Pendulum boom centres

Pendulum boom centres have one pivot point in the middle of the boom centre. The pendulum boom centre reduces the impact on the boom wings when tyres are going over uneven surfaces or holes.

Pendulum boom centre on a Jetstream® sprayer

Pendulum booms can benefit from touchdown wheels.

Photo: Graham Betts

Pendulum boom centres are common on some trailing sprayers and some models of self-propelled sprayers.

High pivot points on pendulum boom centres may cause the boom to move sideways when a tyre goes over an uneven surface or down a hole. This sideways shift may create issues in certain situations, such as nozzle alignment over row crops, or maintaining the position of shielded sprayers or target-selectable units, or in controlled-traffic systems. Having a low pivot point may be an advantage, as there will be less influence on the boom and less sideways movement.

Sensor-based auto boom-height-control systems may not work as intended unless the boom centre can be made more rigid with the addition of boom-roll mechanisms that stabilise the centre section when the individual boom wings are raised and lowered manually or automatically.

TIP
- Tilt rams may need to be longer so the boom can be adjusted below horizontal when spraying on uneven surfaces.

Trapeze boom centres

Trapeze boom centres have two level beams with four pivot points – two pivot points on the top of the boom centre and two on the boom mast. The top two pivot points are narrower than the bottom two pivot points. A trapeze boom centre reduces the immediate effect on the boom level when the tyres go over uneven surfaces.

A trapeze boom centre on a Hardi® sprayer

When combined with AutoTerrain height-control systems, the trapeze boom centres can work very well.

Photo: Graham Betts

Auto boom height may not work as well unless the boom centre can be made more rigid (for example, with additional boom-roll mechanisms) when the individual boom wings are raised and lowered manually or automatically.

However, when they are fitted with systems that can control the height and level of the centre section, as well as auto height control on the boom (such as the Hardi®–Norac AutoTerrain system), they can maintain boom height in very challenging terrain.

Inverted trapeze boom centres

Inverted trapeze boom centres have two level beams with four pivot points – two on the top of the boom centre and two on the boom mast. The top two pivot points are wider than the bottom two pivot points.

An inverted trapeze boom centre reduces the effect on the boom when the tyres go across uneven surfaces. It also maintains the boom height when going around corners but may struggle coming back to level quick enough.

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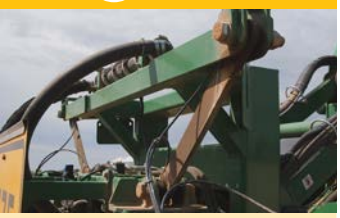


Boom stability - inverted trapeze

Carefully consider the centre section if placing additional weight on the boom.

Photo: Graham Betts

An inverted trapeze boom centre on a Goldacres sprayer

Auto boom height may not work as well unless the boom centre can be made more rigid when the individual boom wings are raised and lowered manually or automatically (for example, boom-roll mechanisms).

Placing additional weight, such as target-selectable sprayer sensors or shielded sprayers, on this type of boom will require the installation of heavy duty compensation rams on the centre section to maintain stability.

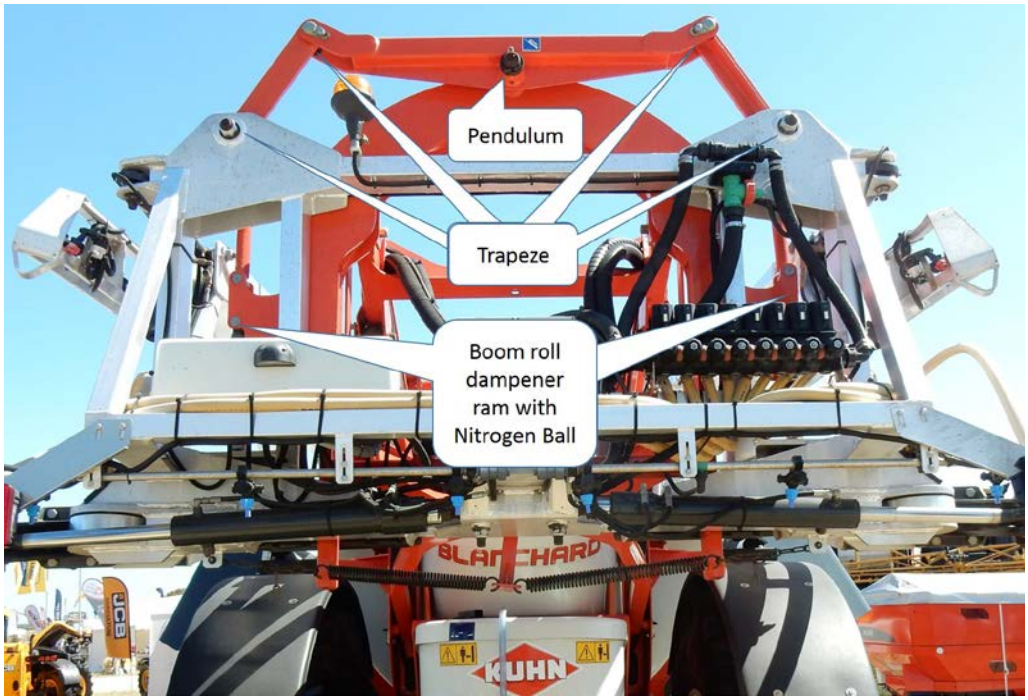
PLAY VIDEO

Boom Stability – pendulum trapeze boom – hardi (coil spring)

Combination pendulum/trapeze boom

Combination centres generally have four pivot points (trapeze) – two pivot points on the boom centre and two pivot points on the boom mast. The top two pivot points are narrower than the bottom two pivot points.

A combination of pendulum and trapeze boom centre on a Kuhn sprayer



Combination centres are very stable without height control.

Photo: Graham Betts

For wider booms without auto height-control systems, this may be one of the better designs for maintaining boom stability.

As with other trapeze boom centres this centre design can reduce the impact on the boom and boom level when the tyres travel over uneven surfaces.

Auto boom height may not work as well unless the boom centre can be made more rigid when the individual boom wings are raised and lowered manually or automatically (for example, with the addition of boom-roll mechanisms).

An example of a boom centre roll dampener

Self-levelling booms require roll dampeners for auto height control to work effectively.

Photo: Graham Betts

4. Systems for maintaining boom height

Any height-control system fitted to the sprayer must be compatible with the boom centre and the terrain on which the operator intends to conduct spraying operations.

Maintaining optimum nozzle height can be helped by rigid touchdown wheels, hydraulic touchdown wheels, automatic (electric hydraulic) touchdown wheels and sensor-based automatic boom-height control.

Auto boom height not working properly over contours

If the sensors are not correctly positioned or calibrated auto height will not function correctly.

Photo: Graham Betts

4.1 Touchdown wheels

Touchdown wheels, also known as 'jockey wheels', are fixed wheels attached to the boom to prevent the boom striking the ground and for maintaining correct nozzle height. They are a good option to help with boom stability if the boom centre is able to roll.

Ideally, touchdown wheels are mounted two-thirds of the way out along the boom on the outer section, before the break away. The wheels need to have some type of cushioning device or independent suspension to reduce the impact on the boom when there is heavy contact by the wheels with uneven ground.

It is important to have the ability to adjust the wheel height up and down to be able to match the required nozzle height to achieve the double overlap at the target or false target. It is also useful to have the ability to move the mounting bracket sideways to match different crop configurations, and mounted near a boom bracing point.

Touchdown wheels may suit many booms.

Photo: Graham Betts

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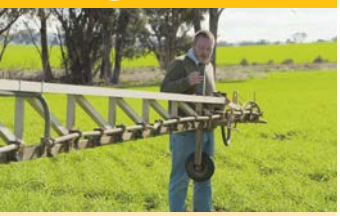


Height control systems – touchdown or jockey wheels

Example of a touchdown wheel

Touchdown wheels with automatic height adjustment

There are two options for installing touchdown wheels with automatic height adjustment: hydraulic or electric hydraulic. When using hydraulics in combination with the touchdown wheel, there is an additional hydraulic block that is adjustable so when the pressure is reduced in the hydraulic line (for example, due to the wheel lowering when following the ground into a hollow), the boom wing ram is raised. When the wheel goes over an obstacle, the ram will do the opposite. This system works very well, particularly for booms that have a pendulum boom centre.

Using electrics and hydraulics, there are limit switches placed on the touchdown wheel suspension that send signals back to the hydraulics to raise or lower the boom.

In both examples, the boom wing lift rams may need to be replaced with longer rams so the boom can go below the horizontal when required.

Hayes auto boom height using wheels and a hydraulic load sensor on the ram

When using touchdown wheels coupled with auto height, the rams should be able to go past the horizontal.

Photo: Graham Betts

TIPS

- Install the touchdown wheel mounting bracket two-thirds of the way out along the boom from the centre of the sprayer, just past the outside fold (not the breakaway) and at a point where the bracing bracket can be mounted from the top to the bottom of the boom. Having the touchdown wheel outside the fold will have the wheel facing out when the boom is folded if using a rear-mounted boom.
- Make brackets that allow the touchdown wheels to be moved along the boom to match the crop inter-row.
- Do not have a rigid mounting point for the tyre, rather a suspension system similar to the back wheel on a motor bike. One possibility is a shock absorber, but a coiled spring could also be used.

Home-made touchdown wheel 'with suspension and adjustment' on Hardi® boom

Adding suspension to touchdown wheels reduces the impact on the boom.

Photo: Graham Betts

4.2 Auto height control using sensors

Auto boom height using sensors is the most popular system for improving the boom's ability to maintain the optimum nozzle height above the target or false target. Sensors are often standard equipment when you purchase a new boom sprayer.

Electronic height sensor

Electronic sensors need to be correctly positioned and regularly calibrated.

Photo: Graham Betts

There are several brands of height-control systems available. Generally, manufacturers or dealers will use one brand over another on their machines due to distribution agreements.

The auto height-control sensors work by sending out an ultrasonic signal, which is reflected by the ground or the crop canopy. The time taken for the signal to return to the sensor indicates the distance from the target to the sensor. Factors such as travel speed, the sprayer or boom suspension and the presence of stubble may impact on the accuracy of some systems.

Many of the sensor units have the ability to select between detecting either ground or crop and it may be important for the operator to 'tell' the height control systems which one is being detected during the spraying operation and calibration.

Some more recently released sensors have the ability to simultaneously detect both crop and ground at the same time, which greatly increases their accuracy and the stability of the height-control system in some situations.

PLAY VIDEO

Auto height – control grower experience

Factors that may affect the ability of the auto boom height to function correctly may include:

- **the boom centre design;**
- **hydraulic capacity of the sprayer;**
- **sensor location;**
- **boom roll;**
- **tyre pressure;**
- **sprayer suspension;**
- **boom suspension;**
- **boom centre tilt;**
- **the ability of the boom centre to move freely (not rubbing on the wear pads); and**
- **the auto height controller software.**

TIP

- **If considering retrofitting an auto height-control system onto an older trailing rig, make sure the tractor has enough hydraulic oil flow capacity to operate the system.**

PLAY VIDEO

Auto boom height systems

4.2.1 Auto height sensors and their position on the boom

The position of the sensors along the boom is important to how well they may perform.

Norac auto boom height sensor on a Miller boom

The Norac UC5 system detects both ground and canopy simultaneously.

Photo: Graham Betts

The ideal set-up on a wider boom would be to have five sensors: one for the centre section, one on each wing and one on each of the breakaways.

The two wing sensors may need to be moved when spraying contour country, so the boom does not get confused when one sensor is picking up the top of a contour and the other sensor is coming up to or going past the top of the contour (this may take a little bit of trial and error).

Each sensor should be mounted where it will not be damaged when folding the boom and where the field of view will not be obstructed by the spray pattern of the nozzles, particularly offset or twin nozzles, as per the manufacturer's recommended height above the nozzle and distance out in front of the boom.

Nozzle spray patterns can cause false readings, where the boom may raise substantially, which can also occur when slowing down with reasonable tailwinds.

TIPS

- **For optimum performance of the auto boom height-control system, consider having five sensors, especially with wider booms and when spraying paddocks with contours.**
- **Some automatic boom height system manufacturers require the sensor to be serviced after a specified number of hours of use.**

4.2.2 Calibration of sensors

It is very important to perform the 'auto calibration' function in the auto boom-height controller. This must be done on level, bare ground and requires measuring the distance from the nozzle or sensor to the ground as per screen example (page18).

Record all of the auto boom function settings, including the date and comments, before making any changes, and always update your settings' records when changes are made.

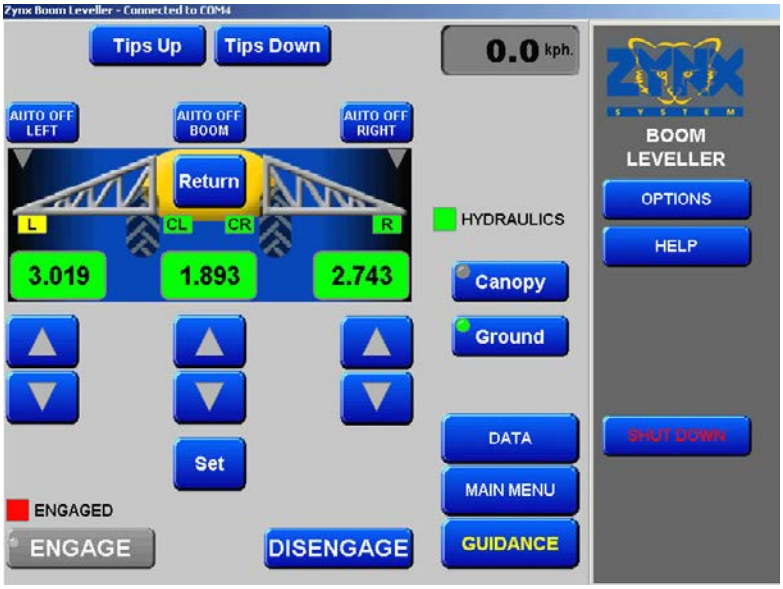
Make sure the boom is full of liquid before doing the sensor calibration, as this may change the balance from empty.

Only perform an 'auto boom' calibration after the hydraulic oil is at operating temperature after doing a few laps in the paddock using the auto boom-height system. It is a good idea to phase the rams before doing the auto calibration. Always complete an auto calibration after changing the hydraulic oil.

Topcon ZYNC boom leveller screen display

Most auto height systems can be integrated with existing screens.

Photo: Ashley Wakefield



TIPS

- Some brands of auto boom height require the sensor serial numbers to be in sequence from left to right, with the lowest sensor serial number on the left to the highest serial number sensor on the right.
- Turn the auto boom height system off when the boom is folded in the cradles during travel.
- Check that the settings are in metric. If working physically in imperial, check that settings are exact conversions from imperial to metric.
- Only ever change one setting at a time.
- The auto boom height system may have to be switched into 'manual' over extreme surface undulations to prevent it making decisions when sensors are out of range.
- Make sure height figures on the monitor change when the boom is raised and lowered.
- Before commencing spraying, physically test sensors by placing a hand under the sensor.

Hand under sensor to check response

Always check sensor responses before spraying.

Photo: Graham Betts

5. A comparison of front-mounted booms with rear-mounted booms

There are both potential benefits and some limitations to having a front-mounted boom in comparison to a rear-mounted boom.

Most spray operators are familiar with the operation and limitations of a rear-mounted boom, so the following discussion focuses on the potential benefits and limitations of a front-mounted boom, relative to the standard rear-mounted boom.

5.1 Potential benefits of a front-mounted boom

Front-mounted booms make it easier for the operator to see all of the nozzles and boom components while they are spraying and they are generally easier to drive into corners (as opposed to reversing a rear-mounted boom).

A front-mounted boom can also be useful for reducing some of the issues associated with poor control in wheel tracks due to air being displaced by the tyres, provided they are not operated at higher spraying speeds (generally above 22 kilometres per hour).

At lower spraying speeds, front-mounted booms may also reduce the amount of spray entering the 'wake' behind the sprayer, which can result in lower drift potential when compared to rear-mounted booms.

Some machines with front-mounted booms enable the interchange of implements, such as windrowers or inter-row cultivators, which may be of benefit to some operations.

5.2 Possible limitations of a front-mounted boom

One of the biggest concerns for operators with front-mounted booms is the possibility of spray chemicals contaminating areas the operator has contact with, particularly when getting in and out of the sprayer and in areas under the chassis when they conduct maintenance.

Generally this is less of a problem when operating with a coarse spray quality or larger, but can occur when smaller droplet sizes are used for fungicide or insecticide applications, and at higher spraying speeds.

A front-mounted boom can cause the boom wings to be very reactive when making steering changes. Negotiating obstacles may require adjustments to driving technique if the operator is more familiar with operating a rear-mounted boom.

On balance, the decision to purchase either system is likely to come down to other features available on the sprayer and the service provided by the dealer.

6. Boom-folding options

Many boom manufacturers offer either bi-fold or tri-fold options to the spray operator when ordering wider booms.

The main reason to consider various folding options for the boom would be to match the width of the centre section of the boom to other implements used on-farm.

While the same result may be achieved with plumbing and section control, the ability to have the outer sections folded during some spraying operations may be seen as a benefit to a number of spray operators. For example, when an operator moves from irrigation blocks to dryland paddocks the planter or seeder widths may vary.

7. Nozzle design and position on boom

Careful consideration needs to be given to the types of nozzles and the nozzle spacing that the operator may wish to use on the boom before they make a purchase.

The position of the spray line and nozzle bodies in relation to the structural components of the boom may be important for determining what nozzle spacing can be chosen, and the type of nozzle pattern that can be operated.

7.1 Nozzle patterns (twin jets and offset nozzles)

Often manufacturers recess the nozzle bodies, or place them behind steel components to avoid damage to the nozzle bodies if the boom strikes the ground.

This may limit the ability to fit ‘twin nozzles’ or to orientate offset nozzles (such as the TeeJet® Turbo, TeeJet® Wide Angle Flat Spray Tips, Turbo TeeJet® Induction Flat Spray Tips, and the Syngenta® Defy 3D) to the boom, as a forward-facing pattern may strike parts of the boom.

It may be possible to purchase extension/adapter caps that lower the position of the nozzle far enough below the steel to avoid the pattern being interfered with, provided the boom can be prevented from striking the ground.

Boom end protection

If adjusting nozzle position, consider boom end protection.

Photo: Graham Betts

An adapter cap to lower nozzle position

Most nozzle manufacturers offer adaptor or extension caps which can lower the nozzle position.

Photo: Graham Betts

7.2 Nozzle spacing

Often the construction of the boom may prevent the nozzle spacing from being adjusted without some modification to the boom. This may be the case with some aluminium booms, which have a reinforcing system to provide strength.

While it may be possible to make cuts to parts of the boom to allow nozzle bodies to be placed where the operator requires, check with the manufacturer to determine what impact this may have on the structural integrity of the boom and to the manufacturer's warranty.

Some boom designs make narrower nozzle spacing difficult

This aluminium boom is set up for a 0.5 metre nozzle spacing. Making adjustments to the nozzle spacing may be difficult.

Photo: Graham Betts

For more information about available height-control systems go to: ravenprecision.com/products/boom-controls and www.norac.ca/products and www.deere.com.au/en_AU/products/equipment/sprayers/self_propelled_sprayers/self_propelled_sprayers.page

9. Summary

Boom stability and height control are critical for maintaining nozzle height, which determines how even the spray application will be across the boom and at the target. Minimising boom height also helps to reduce the potential for spray drift to occur.

Auto height-control systems can work well, provided they are correctly fitted and calibrated, the sprayer set-up is optimised for their use, and the boom centre is appropriately modified where required.

Careful consideration should be given to the boom design and height-control system before purchase, to ensure the set-up chosen best matches the requirements of the operation.

A summary of some of the features of various height control systems is included in Table 2 and links to useful websites are also listed.

Table 2 Examples of auto height-control systems marketed in Australia (as at January 2017).

Examples of height-control systems	Examples of models	Features (summary from the manufacturer's literature)
Wheel-based systems		
Raven®	Auto Boom PowerGlide Plus	• Uses a cushioned wheel in combination with hydraulic lift capabilities • PowerGlide Plus includes a complete system upgrade with CAN bus to use with any Raven field computer • This system is upgradable to UltraGlide (sensor-based) via a simple-to-install upgrade kit • State-of-the-art hydraulics maintain a constant pressure • Simplified one-touch calibration • Compatible with many consoles
Sensor-based systems		
Raven®	Auto Boom, Ultraglide	UltraGlide includes a centre rack control that makes it easy and quick to return to spray and transport modes. Includes CANbus technology for integrated multi-system operations. • In-cab monitoring and adjustments • Simplified one-touch calibration • Five sensor capability • Wheel-mode capability • Compatible with many consoles • Pressure-based control for smoother boom movements and adjustments • Stand-alone controller allows users to add Auto Boom® without a field computer
Norac	Norac UC5™ AutoHeight and AutoTerrain®	Commonly used on Hardi® sprayers. The UC5™ Spray Height Control System can be operated through the tractor's existing virtual terminal or Ag Leader panel, and is available with the NORAC ECHO™ to make it a stand-alone system. The UC5™ Spray Height Control product line is ISO bus 11783 certified. The UC5™ system offers: • new functionality including the ability to detect crop and ground simultaneously; • user-friendly diagnostics; and • integration with existing control electronics OR a compact stand-alone display.
John Deere	BoomTrac Pro™	Can be ordered as a 3-sensor or 5-sensor system. The sensor locations are pre-determined and can be either factory-installed or dealer-installed.
Combination of wheel and sensor-based systems		
Raven®	Auto Boom UltraGlide® with PowerGlide Plus®	Offers the benefits of both wheel and sensor-based systems. Useful for moving from pre-emergent applications to in-crop applications.

NEXT MODULE

SPRAY APPLICATION MANUAL FOR GRAIN GROWERS

Module 15 Weight, balance and tyres Their impact on sprayer performance and safety

GRDC GROWNOTES

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