

Spray Height Control from Norac (from the Profi magazine)

Ultrasonic sensors to retrofit

An automatic height control of the spray boom makes working extraordinarily easier. But what's up, when your sprayer does not have this supplementary equipment and when right now you are missing it? Norac offers an ultrasonic system to retrofit.

In particular

over hilly terrain, but also when using very large boom widths and at high speed, it is not really easy, always to manage manually the height control with precision. „At such a speed, with my 33-m sprayer, I simply cannot look forwards and backwards, as I should, to adjust the working height over hollows or at headland ", said to us the farmer Martin Krist 50226 Frechen. So he had the NORAC Spray Height Control „Total Control" retrofitted on his Berthoud Tenor. Last fall, when the trailed sprayer had just been received, Berthoud had not yet such equipment in their own program to offer.

Altogether three ultrasonic sensors take over the distance measurement on the „Total Control". One sensor is attached to the middle of the boom. It regulates the lift height of the boom center section. The two other sensors, a right-hand and a left-hand on the boom, are responsible for the boom wings.

Thus not only is a basic height control with roll compensation possible, but also an inclination of each wing independently one from the other. So for example over a hollow both wings can be folded up, while the boom center section keeps its height. Over a knoll both arms are folded down, and on a slope a wing angles in a direction while the other does it in another one, when it is made necessary by the terrain.

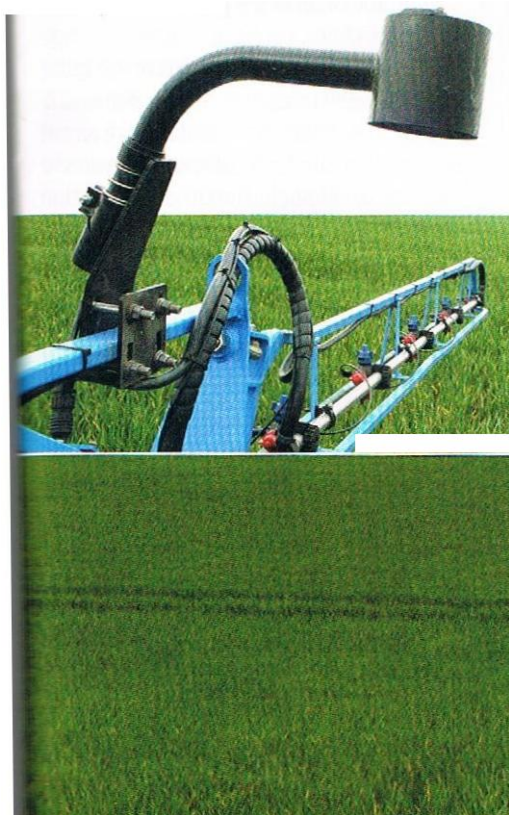
A condition, for such an intelligent height control to be able to function, is, that the plant protection sprayer is fitted with an electrohydraulic control. That means that the operator can (without the retrofitted automatism) initiate the lifting of the boom as well as the angle of the boom wings manually with an angle lever or through keys on the sprayer computer. On the sprayer, there should be valves already available, which can be opened or closed with electrical signals

With the Spray Height Control „Total Control Norac retrofits not just three ultrasonic sensors, or also five on request, and a small control box of a cigarette pack size. Besides these, a proportional valve block of its own design and two roll sensors are part of the system



The ultrasonic height control for spray booms from Norac was here retrofitted

Photos: Böhmisen, Tovornik



The version with three sensors costs 7750 Euro. The costs for the installation of just 750 Euro are to be added.

Someone who does not have a plant protection sprayer with the wing inclination and nevertheless would like to retrofit a height control and an automatic roll compensation, can fall back on the Norac basic version, the „Slant Control". This system functions with two ultrasonic sensors and costs 4600 Euro plus somewhat over 500 Euro for the installation (all prices VAT excluded).

As to the Retrofit Install of the „Total Control" the Norac valve block will be mounted in addition to that of the sprayer itself. The corresponding features for the lifting and lowering of the boom will then be blocked on the original valve block of the sprayer. In the case of an installation with the automatic Spray Height Control directly at the factory, only the valve block from Norac will be mounted.

This is necessary, because for the automatic spray height control the particularly short reaction times and the finely tuned cycle times of the proportional valves are necessary, according to the explanation from Norac. Additionally a temperature sensor in the control block monitors the oil temperature, so that the electronics can adjust the opening times of the valves, depending from the temperature, to the viscosity of the oil

The ultrasonic sensors are functioning in this way:

Distance measurement in the way of the bats

The bats use for orientation a principle similar to the ultrasonic sensors. It means, they emit sounds and hear the echo reflected by the objects.. Thus they can, not only detect obstructions,

but also know at the same time their actual distance to them. But sound waves have a specific speed depending from the temperature and carrier medium : 344 meters per second in air at a 20 °C temperature. Hence through the measure of the time, which the sound needs to go and come back from an object, it is possible to calculate the distance, which the sound has covered during that time. And the bats as well as the ultrasonic sensors emit sound waves in ultrasonic frequency ranges inaudible by humans (20 kHz up to 10 MHz)f. The human acoustic range lies between 16 Hz up to 20 kHz. A person with a very acute hearing can just perceive the lowest pitched tones from some bats. But that simply on the edge.

Ultrasonic sensors change on a given pulse from an emitter and towards to receiver. First they emit the ultrasonic signal, then follows a receiving availability time. This process goes on several times per second. The sensors never scan accurately a point, but rather a conical space.

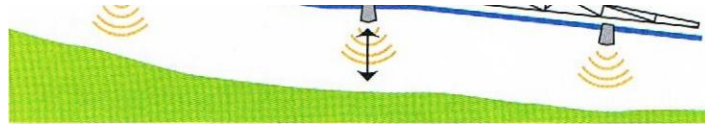
Ultrasonic sensors emit cone-shaped sound waves on a predetermined pulse. If these hit an object, then they are reflected perpendicularly to the propagation direction. The sensor is at the same time receiver for the reflected signals. The electronics changes the signal duration into distance information

drawing: Steinkühler

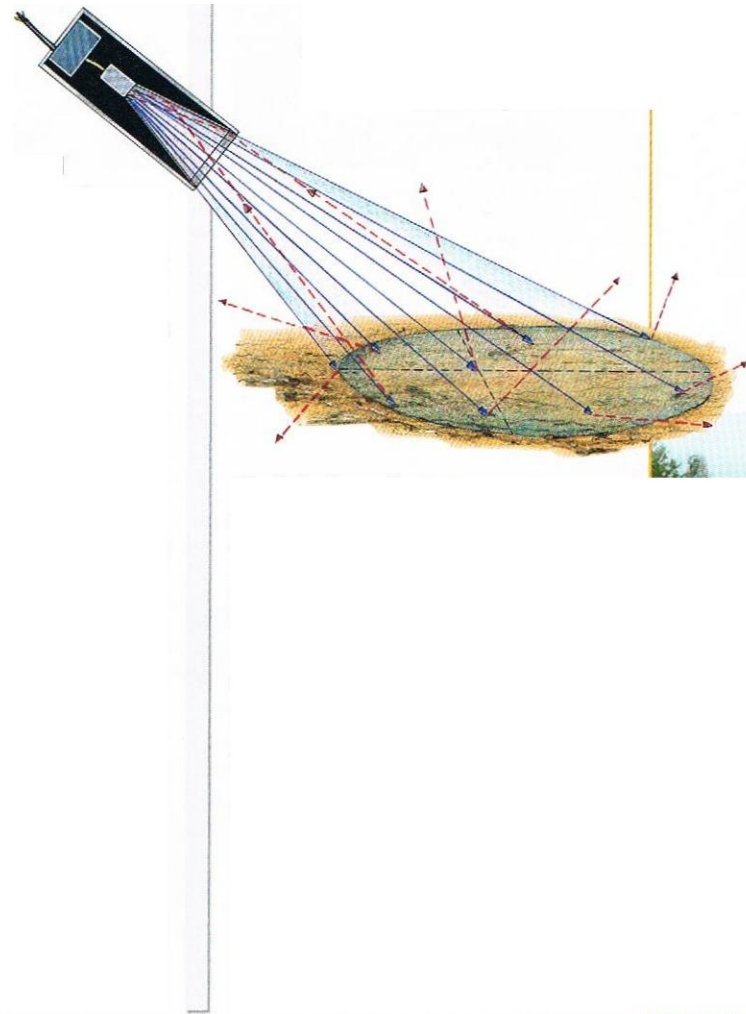
for those who want to know some more exactly : The ultrasonic sound waves are created with the aid of piezoelectric disks,

which start to oscillate with the application of an alternating voltage and emit the corresponding sound waves. In the opposite direction the returning waves initiate also the piezoelectric disks to oscillate, so that the mechanical energy can be transformed as the one in the electrical energy.

The ultrasonic sensors for distance measurement are fitted with temperature sensors, to compensate for the changes in sound speed because of the temperature variations.



With booms with wing inclination functions it is possible to raise or lower the wings independently one from the other. When ultrasonic sensors take over the distance measurement, then that is done automatically. Drawing: Kropp



Advice:

Before testing the boom reaction time

In principle almost every sprayer with electrohydraulic or electropneumatic boom control is adapted to the retrofitting of an automatic height control with ultrasounds. on the basic system (Norac Slant Control) for the automatic roll compensation and the automatic height control of the complete boom structure the existing valves will be used. On the top-of-the range variant (Norac Total Control) an additional valve bloc must be connected to the circuit.

— and this is highly important — before you decide for the installation of an automatic spray height control, you must absolutely test how the boom of your sprayer reacts. Is the damping of the oscillations insufficient, then an automatic spray height control

is not to be transformed satisfactorily. A retrofitting of the system would be money thrown out the window. To „test the boom“, you should unfold the boom and set a height of ca. 60 to 70 cm. up to 70 cm tune. Afterwards you push down one side of the boom completely down to the ground and then release it. In an ideal case the boom moves straight to the horizontal middle position without oscillating after the push. This is still okay, when the boom after being released overshoots the middle position one time and after that remains still. If on the contrary the boom swings one more time beyond the correct horizontal position, then the boom suspension is too unstable for an automatic height control.



With the use of the small control panel the automatic spray height control „Total Control“ from Norac will be activated and set.

The two roll sensors will be mounted on the center section of the spray boom and on the boom frame. You detect the effective position of the boom and see to it, that the boom center section stays always parallel to the slope. In addition the roll sensors provide additional information for the control of the boom wings in severe terrain. Then you detect clearly the terrain unevenness earlier than the ultrasonic sensors and thus you can support the height control.

For an explanation: The ultrasonic sensors activate only then a reaction, when the boom has already moved out of the ideal position. The roll sensors know always beforehand, that the position of the boom has changed, if the electronics does not against it. This knowledge furthermore, if the boom returns or not all by itself during oscillations, the electronics learns it during the calibrating.



In the case of the solution of a retrofitting „Total Control“ one additional proportional valve block will be mounted.

As soon as the system is connected to the circuit, the automatic height control and the plant protection sprayer including the harnessed tractor must first get to know the transmitted information. For that purpose the engineer starts the setup program, which guides him through each calibration step.. On testing all the hydraulic operating functions for raising and lowering the boom on the sprayer computer, first of all he will check, if all hydraulic lines and electrical wiring are properly connected. Besides the measurement readings of the ultrasonic sensors must be adjusted by measuring again the actual distances.

Furthermore the system learns during the setup run, how the boom moves and how the tractor hydraulics reacts. The Norac computer determines automatically the oil flow rate and the valve dead band.

The setup procedure is necessary just once before bringing into service for the first time. Later, e.g. another tractor is connected to the sprayer or the hydraulic pump is replaced, the parameters for the hydraulic valves can be calibrated subsequently with the „ReTune“ function.

For operation: This is carried out through a small box with three toggles and a LED display or alternatively also through an available ISO-Bus-terminal. The operator can set up the sensitivity next to the designated height, at which the automatic spray height control must react. The setting range goes from step zero to ten. Which value is here the adequate one, depends from the boom and the surface

condition of the crop as well as that of the soil. At the highest setting the adjustment control reacts at a height difference of 2 to 3 cm, at setting Nr two it does this only after that the difference is bigger than 10 cm.

the operator can choose between the „Soil“- and the „Crop“-mode, depending on whether the adjustment control should use the ultrasonic signals reflected from the soil or from the canopy of the crop. For the Crop-mode a condition is that the plant coverage is at least 60 Percent, so that the Sensor can „see“ it well enough. This is the case in a well developed crop before the ears stand.

When the coverage has gaps, then the automatic height control is confused. The boom will move non-stop up and down, because the ultrasonic sensors report changing distances.

„I would not like to miss the system“, says Martin Krist, who with his Berthoud sprayer and the retrofitted spray height control „Total Control“ from Norac has already treated more than 1 000 hectares. „The only thing, one should pay attention to : The small control panel is not to be powered on, as long as the boom has not been unfolded. Otherwise the system does not bring the boom in the desired position.“ And a toggle from Soil to Crop mode on the move is also not so well accepted. This „demo-effect“ could we notice personally during field operation.

Distance-Control from Müller-Elektronik

With the Distance Control, Müller-electronics has likewise in their range an automatic spray height control, which functions with ultrasonic sensors. Admittedly as end customer, you could not buy the control, to retrofit it on your plant protection sprayer. But rather Müller-Elektronik offers the system only as original equipment to manufacturers who are its clients, such as Dammann, Amazone or Lemken.

Alike Norac, Müller-Elektronik mounts also a roll sensor, which determines the actual position of the boom. Additionally the position of the cylinder for the roll adjustment of the boom is potentiometer measured through a potentiometer.

Müller-Elektronik recommends repeating the calibrating of the distance control before the beginning of each season, because the relevant parameters may have changed because of wear on the boom for the adjustment control.

Other than Norac, Müller-Elektronik uses always the first ultrasonic echo. That means that, when a crop coverage exists, the distance will be automatically determined to the canopy. Thus the working height must not be set anew for each field. There is no toggle from ground to Canopy. Müller-Elektronik statement to it: „When the sensor looks at the soil through plant coverage, the signal will be imprecise. Then it must strongly filtered to get reasonable values.“

BoomTrac from John Deere

John Deere offers for their plant protection sprayer of the i-series the automatic height control BoomTrac as factory-fit option with a price supplement of 3 300 Euro VAT excluded. The complete i-package including GreenStar2 Display 2600, automatic boom section switches, GPS navigation receivers and SF1-Licence costs for the pull type sprayers some 7 700 Euro.

On the terminal the operator can choose between two work modes: Either the sensors should compensate only the boom roll or but additionally adjusts the height automatically to the crop.

For the turn at headland there are different possibilities to choose from: |

- The automatic height control BoomTrac remains active without boom lifting.
- The boom moves according to the setting. E.g. about 50 cm upwards, and BoomTrac remains active.
- The boom moves upwards, and BoomTrac is disconnected.
- The automatic height control is deactivated.



„BoomTrac“ is the name of the automatic spray height control from John Deere. Also here the distance measurement is carried out with two ultrasonic sensors right and left on the boom.

Conclusion: The Canadian company Norac offers now an automatic height control for spray boom for retrofitting. The basic variant for the roll compensation costs 4 600 Euro, the variant, which allows also an automatic inclination of the boom wings, can be had for 7 750 Euro. In addition come the costs for the mounting and the Tax value added. On larger working width and for operation on sloping and hilly terrain such an investment is surely worth it.

Anja Böhrnsen



Die Bedienung erfolgt über das ISO-Bus-Terminal. Hier können auch verschiedene Modi für das Verhalten am Vorgewende eingestellt werden.

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The operation is carried out through the 150-Bus-terminal. Here also different modes for the behavior on headland can be set. (this is the translation of the picture caption)

Norac Distribution

Norac is a Canadian manufacturer, which offers weighing systems and since 1997 the spray height control with ultrasonic sensors. Sprayer manufacturers such as Kverneland-Rau, Hardi (profi 6/081) and Berthoud mount at the factory the Sensor system Norac at the factory on request.

From March 2010 the company geo-konzept in Germany and Austria has been responsible for the distribution of the retrofit systems „Slant Control“ and „Total Control“ from Norac.

Further Info:

www.norac.ca

www.geo-konzept.de