



Specialist information for soy producers and processors

Camera guided hoeing

Weed control is still the greatest challenge in soybean cultivation. This applies equally to organic and conventional producers. The problem is aggravated by the increasing labor shortage in agriculture. The basis of clean stands is of course an adapted crop rotation and soil cultivation. However, in a crop with slow youth development such as soy, there is usually no way around several passes with the mechanical hoe in organic farming. A good camera guidance can make the hoeing much easier and above all increase the area output of the hoe. Camera guidance is also increasingly used in conventional agriculture. Usually, the aim is to save costs for expensive special herbicides, for example in large-scale lettuce cultivation or sugar beets.

In Taifun contract farming in Central Europe, around 40% of the soybean area is already being hoed using camera guided systems. Experience has been positive. For areas of more than 45 ha of root crops, the investment usually pays for itself within a few years. Accordingly, almost all the larger and many of the medium-sized farms are considering to make a purchase. We have composed the main facts on the subject for you.

Functional principle

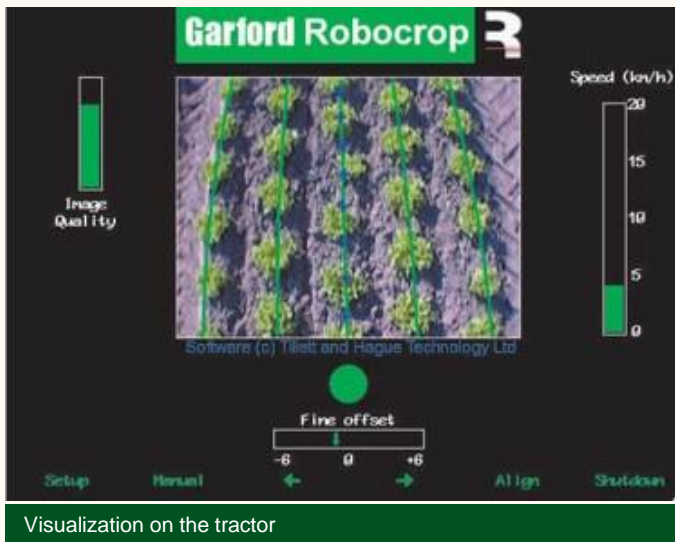
The basic principle of a camera guided hoe is simple: a camera mounted on the tool bar films one or more plant rows. A computer on the tractor evaluates the images according to the intensity of the green color and continuously calculates where the blades are running. The computer finally controls a hydraulic side-shift of the frame. The entire frame is positioned with centimeter accuracy in the track, even if the tractor driver is zigzagging.

The driver can follow the lateral displacement and make fine adjustments via a monitor. The mounting of the frame on the guidance system is simple. Thus, crops with different row distances can be hoed by attaching a different frame to the guidance system.

A bottleneck are the row beginnings. If required, the side-shift control can be fixed for manual control of the hoe. This is necessary in heavily weedy stands or on headlands when the camera cannot safely detect the partially run-down rows.



Garford side-shift control with track wheels. The tripod with the camera is mounted on the right side of the chopping frame.



Visualization on the tractor

Despite the possession of a camera guidance system, some larger farms are using a conventional hoe for the hoeing of the headland. Like this, the camera can be used to full capacity on the main areas at peak times.

If a small tractor or a tractor with a deflected suspension is used, the side-shift control can be stabilized by using supporting wheels.

Market overview

There are about a dozen manufacturers of camera guidance systems in Europe (see overview below). Most of them also offer hoeing frames, but it is possible to buy only the control unit and attach your own hoe. Garford from England was previously regarded as the undisputed Mercedes among the suppliers with its Robocrop system. The camera captures three plant rows simultaneously, so there are no problems even for large gaps in single rows. At the end of the row, the hoe automatically centers itself and the control system can be operated manually while the machine is in motion. The side-shift control is precise and robust, the visualization on the tractor is helpful and easy to operate. The entire system is well-engineered and has been proven many times over. Only the high price made growers regularly test alternatives: the catalogue price for a ready-to-use set without a hoeing frame is around 21,500 euros.

Recently Garford has been facing serious competition from Einböck. The manufacturer of hoeing technology, which previously distributed Garford technology in Austria, has developed a well-engineered, solid and above all significantly cheaper alternative with the Row-Guard system.

The ready-to-use set has a catalogue price of about 13.00 Euro without a hoeing frame. Since its introduction last autumn, more than 40 units have been sold. So far, we have not received any complaints. On the contrary, the users we know are completely satisfied. The only thing missing in the current version is the possibility to manually intervene in the control system while driving, but this is usually not a significant criterion. As with Garford, the standard version of the machine is suitable for working widths of up to approx. 6 m. For larger hoeing frames, there is version with a more stable side-shift control where the lateral displacement runs on solid sliding tubes.



System with track wheels and stable parallelogram for hydraulic lateral displacement (Photo: Steketee, Netherlands)

While Garford uses its own components, Einböck and various other manufacturers generally use cameras, computers and software from Claas (Agrocom Eyedrive). Only the side-shift control is individual for each manufacturer. With Schmotzer, it is carried out via guided wheels on the frame - which, according to several growers, is very detrimental to precision. Steketee, a Dutch manufacturer of technology for vegetable cultivation, uses a parallelogram for its "EcoDan" system. The technology also seems to work well. The catalogue price without hoeing frame is about 16,500 Euro. According to the manufacturer working widths up to 9 m can be mounted.

The new Claas cameras work with two lenses (stereo camera). Theoretically, the lenses can be adjusted for different lighting conditions, allowing a better adapting of the system to difficult situations such as backlighting or twilight. In the coming years, manufacturers expect further developments in the precision and performance of cameras and computers.

As an alternative to lateral displacement, the Claas-camera can also be combined with a track steering system. The hoe should then be front-mounted due to the more direct transmission of the steering movements. It is controlled by an automatic steering of the front axle. The system works faultless. The price is comparable to a Garford side-shift control, yet it comes with the advantage that the tractor steers itself. However, according to Claas, the system will never be as precise as a side-shift control, because the latter steers the hoeing frame directly, whereas the controls of the automatic steering system must first be transmitted from the front axle via the suspension to the chopping frame.

For the time being, Claas will not introduce a side-shift control, but will further develop the camera system. ISOBUS certification is planned. Then the camera control could be carried out via an ISOBUS terminal already installed on the tractor. Hence, no separate computer and monitor for the camera guidance must be bought. Recently, a new camera has been introduced, to which a second monitor can be connected. This allows the driver to see how the hoe is working in real-time.

Manufacturer Hoe	Country	Make Camera/computer
Agronomic	F	Claas
Carre	F	Claas
Einböck	A	Claas
Garford	GB	Garford
Gothia Redscap	SE	Claas
Kongskilde	DK	Claas
Maschio Gaspardo	IT	Claas
Poulsen	DK	Poulsen (?)
Schmotzer	D	Claas
Steketee	NL	Claas
Thyregod	DK	Claas



Camera vs. RTK

It is often discussed whether the future in hoeing technology belongs to camera guided systems or RTK (GPS control). RTK requires a local transmitter, otherwise the precision is not sufficient. RTK transmitters are now provided in many places by contractors or machinery rings. If the RTK is mounted on the tractor, even a slight slope leads to errors because the hoeing frame deviates slightly downhill. One option would be to mount the RTK on the hoeing frame and accordingly on the seed drill for sowing. Growers who have RTK on the tractor use it for sowing and the very straight rows simplify the work with the conventional hoe. Perfectionists combine RTK and camera. The track guidance of the tractor is then realized via satellite, the fine tuning of the hoe is done by the camera guidance. However, the devices must be coordinated so that they do not work against each other. It is not yet clear which of the two techniques will prevail in the long run.

Advantages and disadvantages of the camera guided hoe

It cannot be said that hoeing is in principle more precise with a camera guidance. Even with conventional techniques weeds can be kept in check under normal conditions. However, a functioning camera guidance system offers the following decisive advantages:

- Driving speed is higher. While the driving speed with a conventional system is usually at 5-6 km/h (maximum 9 km/h), a good camera guidance allows driving speeds of 10-12 km/h. Under optimal conditions (very even surfaces, no stones, perfect plant rows) and with robust crops, the machine can be driven at up to 20 km/h. For soy, 10 km/h is standard. In addition to the higher area output, a better quality of work can also be achieved due to the higher driving speed. The soil is moved more strongly and correspondingly more weeds are buried, also in the crop rows.
- The driver is enormously relieved. Instead of having to pay attention to the hoe non-stop, the driver can concentrate on the tractor and work much longer without a break.

- The system can be used by untrained personnel with little experience. In principle, it is sufficient if someone can drive a tractor and is briefly instructed in how the technology works. Up to now, hoeing has rightly been a matter for the boss on many farms - in a time of peak workloads. With a functioning, well-adjusted camera guidance system, the farm manager can take care of other things.

But it is not without reason that many farms have so far shied away from investing. There are also disadvantages:

- The high price of a good camera guidance system is probably the biggest stumbling block. In the past, the investment has generally only paid for itself in the case of areas of more than 60 ha and working widths of over 3 m. This has improved with the introduction of the less expensive Einböck devices.
- The significantly higher driving speed in the field requires a tractor with higher pulling force. In order to ensure that the system runs smoothly, a higher tractor weight is also required. For example, Garford recommends a minimum of 80 HP at 3 m working width and a minimum of 120 HP at 6 m. For the good old Fendt GT 275 the last hour has struck with the purchase of a camera guidance system...
- The higher driving speed increases wear and fuel consumption.
- Camera guidance gives us another mean to solve problems with technology. However, technology does not make for good agriculture. At best it is an aid. A failed soybean cultivation does not get better by investing in expensive technology. Good organic farming is characterized by the right decisions made by farmers at the right time. Yet, technology can make it easier to implement the right decisions. However, weeds can indicate wrongs in the field. If a perfect hoeing technology allows us to eradicate weeds, this may catch up somewhere else as we cannot see the root of the issue.

Weed control as contract work?

Many soybean producers run small and medium-sized farms where the purchase of a camera guidance system is not worthwhile. If there are other farms with root crops within a 20-30 km radius, contract work can make the technology profitable. The biggest challenge is that sowing and hoeing cannot be separated. A shared hoe requires a shared or at least an identical seed drill. Ideally, one person does both sowing and hoeing. One possibility for a simple inter-operational use could be that only the tractor and camera guidance system, but not the hoeing frame, are shared. The exchange of the hoeing frame is quick and easy. The row spacing and dimensions of the hoeing frame can be quickly entered via the control console on the tractor. This way, every farm could continue to use the existing technology for the time being - and, if necessary, hoe with its own tractor without using the camera guidance if the shared machine is not available at the desired time.

As a rule-of-thumb, a camera guidance with a 6 m hoeing frame can handle 100 ha of root crops when planning four passes. In the case of highly fragmented or small fields and long journeys, the area is reduced considerably. Rule-of thumb: an area of at least 45 ha (with 3-4 passes) is required in order to amortize the equipment quickly.

Farmers are generally reluctant in handing over the control of hoeing in soybean cultivation. As always, it is decisive for a successful wage model that someone feels fully responsible and that full attention is paid to the optimal use of the machine during the hoeing season. There are Taifun contractors in both France and Austria who help to sow and hoe soybeans for neighboring smaller farms. In Burgundy, for example, three companies have jointly purchased a Garford system. In England several camera guided hoes are already operated by contractors, not only on organic farms.

Assessments from practice

Joachim Schneider, Hofgut Martinsberg, professional organic farmer near Tübingen and Taifun soybean supplier: "After intensive consideration of the topic, we are convinced that the classic combination of attachment carrier and inter-axle hoe is the better solution for us. The direct view on all blades by the driver himself facilitates fine adjustment on the machine. In addition, the GT can make use of further mounting spaces, for example for mounting a harrow at the rear or another hoeing component at the front. The blades run in front of the tracks of the heavy rear wheels. If I should ever decide on a camera guidance system, it would be one that takes over the steering of the tractor. Then I'll have a real relief. Instead of investing in an expensive camera system with questionable additional benefits, we have invested in another attachment carrier."

Nicolas Meliet, Bio-Gascogne, organic large-scale farm and Taifun soybean supplier, Southern France: "So far, with every expansion of our area we had to buy another attachment carrier. Last winter we put an end to this with the purchase of two 6.5 m wide Garford hoes with a camera guidance system. The devices have done a very good job. This season we have hoed 500 ha of root crops 2-3 times; the area output is now really good thanks to the camera guidance and the large working width. it was definitely the right decision."

Conclusion

Of the numerous suppliers of camera guidance systems, Garford and Einböck are by far the most important. The market launch of the Einböck guidance system has led to a significant price reduction, which has had the immediate effect of accelerating the spread of the technology. While the hardware seems to be largely well-engineered, there are still larger developments to be expected for the camera and software.

On large organic farms, automatic guidance systems for hoes will soon be standard. Medium-sized companies are also increasingly investing in technology. Smaller farms suffering from labor shortages are well advised to think about machine cooperatives for hoeing.

Due to increasing bans and rising costs for herbicides, the technology will also gain importance in conventional agriculture. It is to be hoped that it will further enable conventional soybean producers to avoid or at least reduce herbicide use.

For comprehensive information on all aspects of soy cultivation visit:

www.sojafoerderring.de

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