# How the Quick Hitch Guidance Systems Work and Their Practical Applications

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### *Abstract*

*This article explains the operation of the two types of quick hitch guidance systems on the market. Techniques for farming with precision guidance are offered.*


## Introduction

Implement guidance systems offer several potential benefits to farmers:

- On flat ground, these systems can maintain positional accuracy within 1.5 centimeters, which is about 9/16" (Kocher, et al., 1994).
- Reduced operator fatigue.
- Less skilled drivers can operate precision equipment.
- Higher implement speeds and productivity (Thacker and Coates, 1995a).
- If used for listing and planting, the guess row spacing can be held to very tight tolerances. This enables six-row farmers to harvest with all four-row pickers.
- Reduced weed pressures and hand weeding requirements (Thacker and Coates, 1995a).
- Pesticides can be applied in small bands with high precision.
- The ability to perform high-precision operations at night and in dusty conditions.

The most popular implement guidance systems on the market are quick hitches, with the implement side of the hitch moveable relative to the tractor side. They are intended to be left on the tractor and can be used either as an active guidance system or as an ordinary quick hitch (with the guidance turned off).

Quick hitch guidance systems address the implement handling problem known as "tailout" or the "streetcar" effect. When guiding an implement by steering the tractor, the geometry of the tractor and implement combination work against accurate implement positioning. As shown in Figure 1, when the front of the tractor moves in one direction, the implement immediately moves in the opposite direction. This is especially problematic with long implements and in curved rows. It is a major limitation of guidance systems which steer the tractor.

There are a number of guidance systems on the market which are built into quick hitches. Fundamentally, they are a movable interface between the implement and the tractor. They are of two types, side-shift (push) and articulated (pivot). All of these are electro-hydraulic, which means that they have a sensing device which sends electric signals to actuate hydraulic rams and move the hitch.

## Side-shift (push) Guidance Systems

The action of a side-shift guidance system is shown in Figure 2. The implement side of the hitch (shown in black) slides laterally relative to the tractor side of the hitch (shown in white). The sway stops of the three point hitch are used to transmit shifting forces from the tractor to the implement.

Side-shift systems keep the implement parallel to the tractor axle at all times. This limits the ability of a side-shift system to compensate for "tailout" when the tractor is not parallel to the rows, as shown in the middle of Figure 2. This can be a problem with long implements.

An advantage of side-shift systems is that the implement does not need to have lateral stability to respond to the pushing action of the hitch, thus it is not necessary to add stabilizer disks to implements. However, a disadvantage of side-shift systems is that implements with a great deal of lateral stability will resist sideways movement, hence side-shift systems cannot effectively control highly "directional implements".

Side-shift guidance systems include the following:

| Manufacturer | Trade Name |
|---|---|
| Fleischer Manufacturing | Buffalo Scout II Shifter |
| HR Manufacturing | Navigator |
| Sukup | Slide Guide |

## Articulated (pivot) Guidance Systems

The action of an articulated guidance system is shown in Figure 3. The principle is to lead the implement to where it needs to go, rather than to push it laterally. Articulated systems do this by pivoting the implement side of the quick hitch. This action points the implement in the direction it needs to go.

This rotating action is most evident in the middle of Figure 3, with the implement rotated in relation to the tractor axle. Articulated systems can completely eliminate "tailout", thus they have a clear advantage with long implements and in curved rows.

This rotating action can also align the implement parallel to the rows when the tractor is mis-aligned parallel to the rows, as shown on the right side of Figure 3. This is because articulated systems operate with the sway stops of the three point hitch in the upper storage position. This allows the quick hitch to swing laterally on the draft arms of the three point hitch.

Implements must have a great deal of lateral stability or "directionality" to respond well to articulated guidance. Implements such as no-till planters and cultivators already have this pronounced tendency to travel in the direction they are pointed. However, implements such as listers and many cultivators do not have enough directionality to respond well to articulated guidance. Virtually any implement can have effective directionality added by bolting on one or two stabilizing coulters.

Articulated guidance systems include the following:

| Manufacturer | Trade Name |
|---|---|
| Fleischer Manufacturing | Buffalo Scout II |
| John Deere | Row Trak |
| Lincoln Creek | The Guide |
| Orthman | Tracer |
| Sukup | Auto Guide |
| Sunco Marketing | Acura Trak |

## The Practical Use of a Quick Hitch Guidance System

All of these systems work by sensing either a furrow or the crop row. Our experience shows that the accuracy of a guidance system can be no better than the action of the sensing element in the furrow or crop row. That is the principle challenge in making these systems work well. Here is how we and others have used them:

Listing Rows:

The first pass across the field is done manually as usual. Very good row markers are required to make reference furrows for the guidance system to follow on subsequent passes.

The sensing element used for listing is called a "furrow guidance weight" or "ridge mark kit". It is essentially one or two pieces of cast iron in a tear-drop shape, mounted on a trailing arm. This sensing element is mounted under the center of the quick hitch, and drags in the row mark of the previous lister pass. The guidance system keeps the lister centered accurately over the row mark. This eliminates the problem of varying "guess rows".

Planting:

The "ridge mark kit" or a "ridge sled" is used to actuate the guidance system and keep the planter centered on the beds.

When planting, it is a good idea to leave a reference furrow for the guidance system to follow in the next operation. A small sweep or shovel mounted in the center of the planter will usually suffice. Alternatively, reference furrows can be made in other furrows where wheel traffic will not obliterate them.

In some conditions, a rolling marker or furrower may be preferable to a fixed shovel. Using single-rib tires on the planter gauge wheels may be all that is required to leave reference furrows (this would require the use of an "external sensor mount bracket" or "outboard mounting kit" on the next implement to position the sensing element in the gauge wheel furrow). In cloddy conditions, a combination of a shovel followed by a single-rib tire may be the best alternative.

De-Capping:

Where cotton is planted into moisture under a cap, a challenge of using a guidance system is to remove the cap without obliterating the reference furrow. If you lose the reference furrow, you won't be able to use the guidance system until the cotton gets large enough to actuate the crop wand.

We have maintained the reference furrow by using the guidance system while de-capping. It is a simple matter of re-running the reference furrow with a shovel on the rear of the de-capping implement. This precision de-capping operation dictates that the de-capping implement must be mounted on the three-point hitch and will look more like a cultivator than a drag harrow. We put one together with planter clod pushers and snow chains on a toolframe and it worked well. There is at least one precision cotton de-capper sold commercially as a three point mounted implement.

Another possibility is to add the de-capping tooling to a cultivator and combine the de-capping operation with the first cultivation. Since the guidance system will steer the implement according to a reference furrow laid down by the planter, the driver does not need to see the plant rows in order to cultivate.

Cultivating:

The first and possibly second cultivations will require the use of the reference furrow. When the cotton gets to be about four inches tall, crop wands can be used to sense the plant rows and actuate the guidance system.

Crop wands are long. An "external sensor mount bracket" or "outboard mounting kit" can be used to relocate the wands out from under the center of the quick hitch to one of the front corners of the implement. This will keep the wands clear of the cultivator tooling and make wand adjustments much easier.

Band Applications of Herbicides:

A benefit of precision guidance is that herbicides can be applied in very narrow and accurate bands, while steel is used to kill weeds between the rows. However, we do not recommend trying to perform spraying and cultivating operations at the same time. The efficacy of many herbicides is reduced if dirt is thrown on the weeds while the spray is still wet. This will require low travel speeds if the implement is cultivating while spraying. Our experience has shown that this results in an operation that is not optimal for either task (Thacker and Coates, 1995b).

General Operating Characteristics:

We have gained considerable experience with two of the implement guidance systems and have found them to be very reliable. Most of the difficulties we have had related to the operation of the sensing element, specifically in having a crop large enough to actuate the crop wand and in maintaining and following a reference furrow.

## Summary

Machine guidance systems are part of the "precision farming" technologies now entering the market. This technology offers several potential benefits to the grower and warrants serious consideration.

## Acknowledgments

This project is supported by a grant from the U.S. Environmental Protection Agency through the Arizona Department of Environmental Quality.

## References

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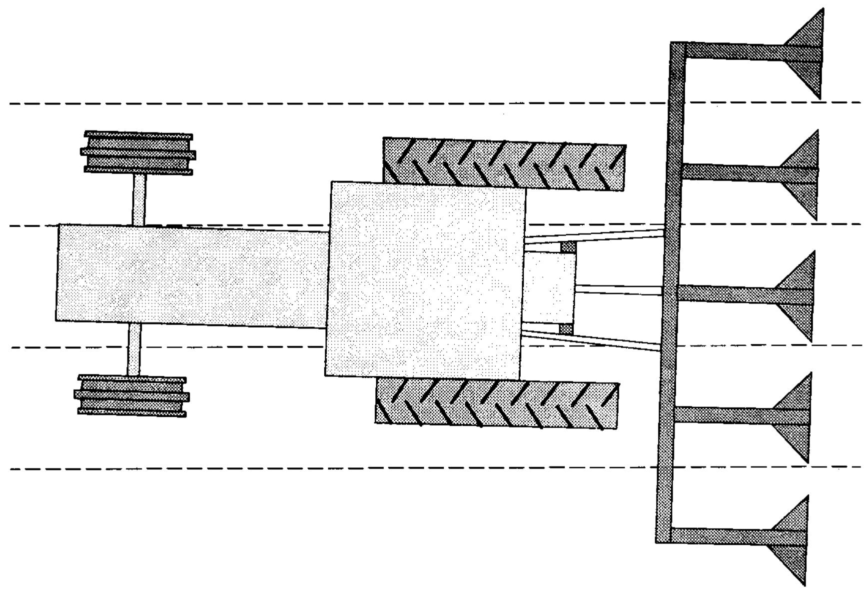

Figure 1. Implement "tailout" caused by the geometry of the tractor and implement combination. When the front of the tractor moves in one direction, the implement immediately moves in the opposite direction.

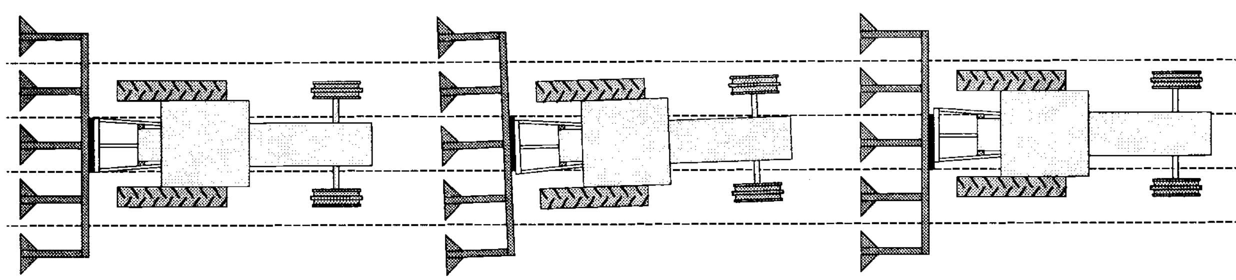

Figure 2. The action of a side-shift or push guidance system; showing (left) both tractor and implement correctly aligned to the rows, (center) the tractor out of parallel to the rows and the implement tailout partially compensated for by the side-shifting action of the guidance system, and (right) tractor mis-aligned and parallel to the rows with the implement correctly aligned to the rows.

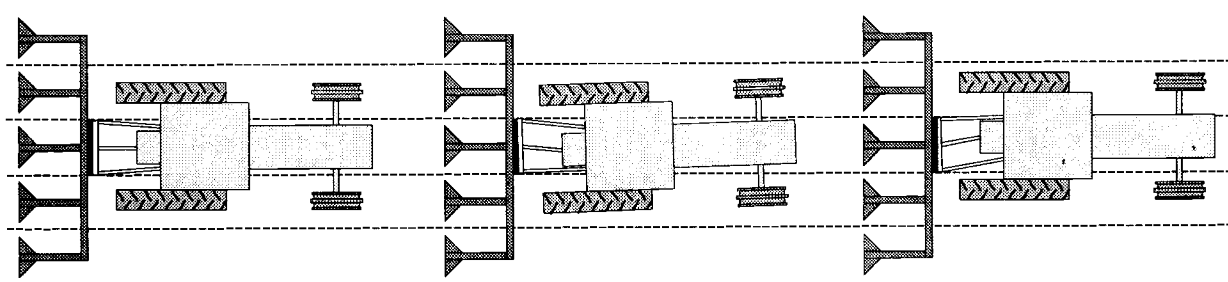

Figure 3. The action of an articulated or pivot guidance system; showing (left) both tractor and implement correctly aligned to the rows, (center) the tractor out of parallel to the rows and implement tailout completely compensated for by the pivoting action of the guidance system, and (right) tractor mis-aligned and parallel to the rows with the implement correctly aligned to the rows.