K-STATE Research and Extension

Field Efficiency Gains You Can Expect from a Guidance System

***Randy R. Price**, Assistant Professor and Engineer, Precision Agricultural Technology*

Introduction

Guidance systems are one of the most cost-effective precision farming tools available today, and a well-working guidance system can increase field efficiencies up to 10 percent. Still, quantifying a guidance system's exact return to a farming operation — from differences in guidance system accuracies and price — is hard to determine. This publication provides several graphs that help you determine the field efficiency increase you can expect from adding a guidance system, or choosing one type of system over another. All calculations are based on implement width so the only information needed is the toolbar or implement width of that piece of equipment. This field efficiency number can then be used to calculate direct savings in time or cost of that operation.

The Guidance System Overlap and Field Efficiency Relationship:

Although stress relief and hands-off driving are good reasons to purchase a guidance system, the real economic advantage of a system is the control of toolbar overlap during multiple passes. This parameter doesn't always require absolute accuracy (i.e. surveying grade GPS equipment), just good overlap control from one pass to another. The typical field efficiency increase (FEI) when applying one guidance system over another is given in Equation 1.

Once these values are known, the field efficiency increase (FEI) can be calculated. The reduction in time, labor, and equipment costs can be calculated by multiplying the FEI value in decimal form times the cost or time taken to perform that operation. This number will give a farmer or operator a good sense of the exact savings from that guidance system.

Typical Guidance System Overlaps:

In the United States, WAAS, OmniStar, and RTK are the three main types of guidance systems, based on correction type, accuracy, and price. (See MF2942, *Choose a GPS System Based on Farm Needs*, for more information about the three types of guidance systems.) Table 1 lists the general overlap control abilities of each system based on pass-to-pass field work (relatively short return pass work typically less than 10 to 15 minutes per pass).

Table 1: Typical Guidance System Overlap Settings*

Guidance System	Typical Overlap Settings – in.
WAAS	12 – 15
OmniStar	6 – 8
RTK	3 – 4

* Note that these overlap values are only estimated values and individual units may perform better or worse depending upon manufacturer, environmental conditions, GPS constellation, and accuracy at time of use.

Equation 1

$$\text{Field Efficiency Increase (\%)} = \left[\frac{\text{Overlap Control}_1 - \text{Overlap Control}_2}{\text{Toolbar Width}} \right] \times 100$$

Where:
Overlap Control_1 = Overlap Control of Original System (ft.)
Overlap Control_2 = Overlap Control of New System (ft.)
Toolbar Width = Toolbar or Implement Width (ft.)

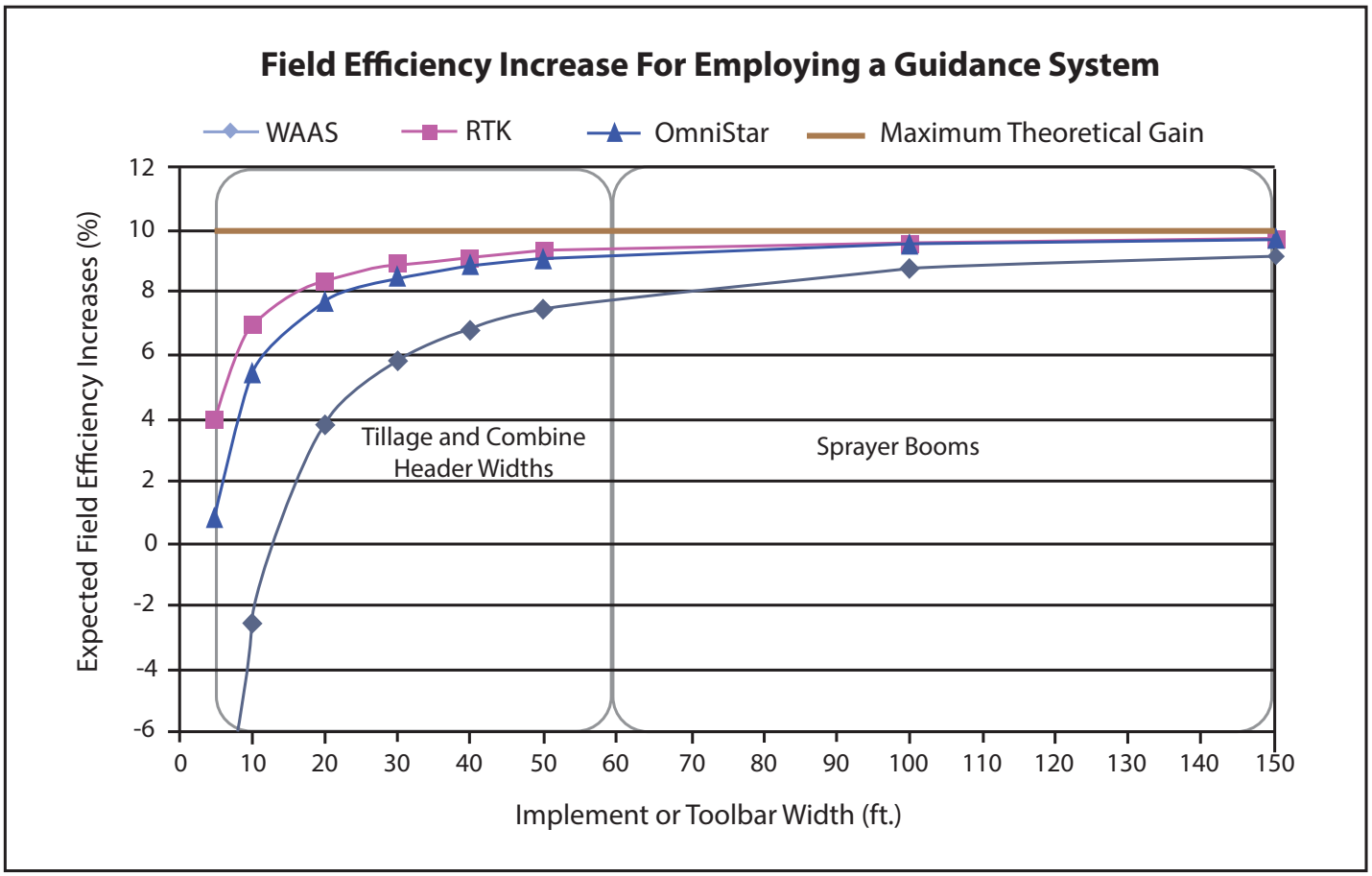

Figure 1. Expected field efficiency increase from employing a guidance system over an un-aided driver.

In the machine-human interface, the typical unaided driver has an overlap error of 10 percent of the toolbar width. That overlap value is plotted against the values in Table 1 using Equation 1 to create Figure 1. This graph allows you to quickly determine the field efficiency increase (or gain) you can expect from employing each of the different guidance systems over an unaided driver.

Note that in this graph, the field efficiency gain increases as the toolbar width increases from 10 to 120 feet for all guidance systems, with a maximum efficiency gain equal to the operator's average error of 10 percent. For better drivers, those with an average overlap error of only 5 percent, the values in Figure 1 would be cut in half, with a maximum efficiency gain of 5 percent and all other numbers divided by 2.

Note also that with larger toolbar widths (sprayer booms, etc.) the type of guidance system is less critical and a WAAS-type guidance system gives nearly the same efficiency increase (9 percent) as an RTK system (9.5 percent). At smaller toolbar widths (20 to 40 feet) the efficiency increase is different, and an RTK or OmniStar system gives nearly a 2 to 3 percent efficiency increase over a WAAS-type guidance system.

For this reason operators may want to pay closer attention to the type of guidance system used when toolbar or implement widths are less than 60 feet. For toolbar sizes less than 10 feet (mowers, etc.), the field efficiency number for a WAAS-type system becomes negative, and the unaided driver can provide better overlap control than a guidance system. In this case, an RTK or OmniStar system must be used.

The field efficiency numbers in Figure 1 are a powerful tool for quickly determining cost and time savings for an operation. For instance, if you have a tillage operation applying nitrates with a 40-foot toolbar that has a yearly operational cost of $100,000, adding a WAAS guidance system over an unaided driver can save up to $7,500 (7.5% [or 0.075] × $100,000) per year, and an RTK system would save up to $9,000 (9% [or 0.09] x $100,000) per year.

For other farming factors, such as reducing time in the field, multiply the FEI number times the time normally taken to perform that operation. For instance,

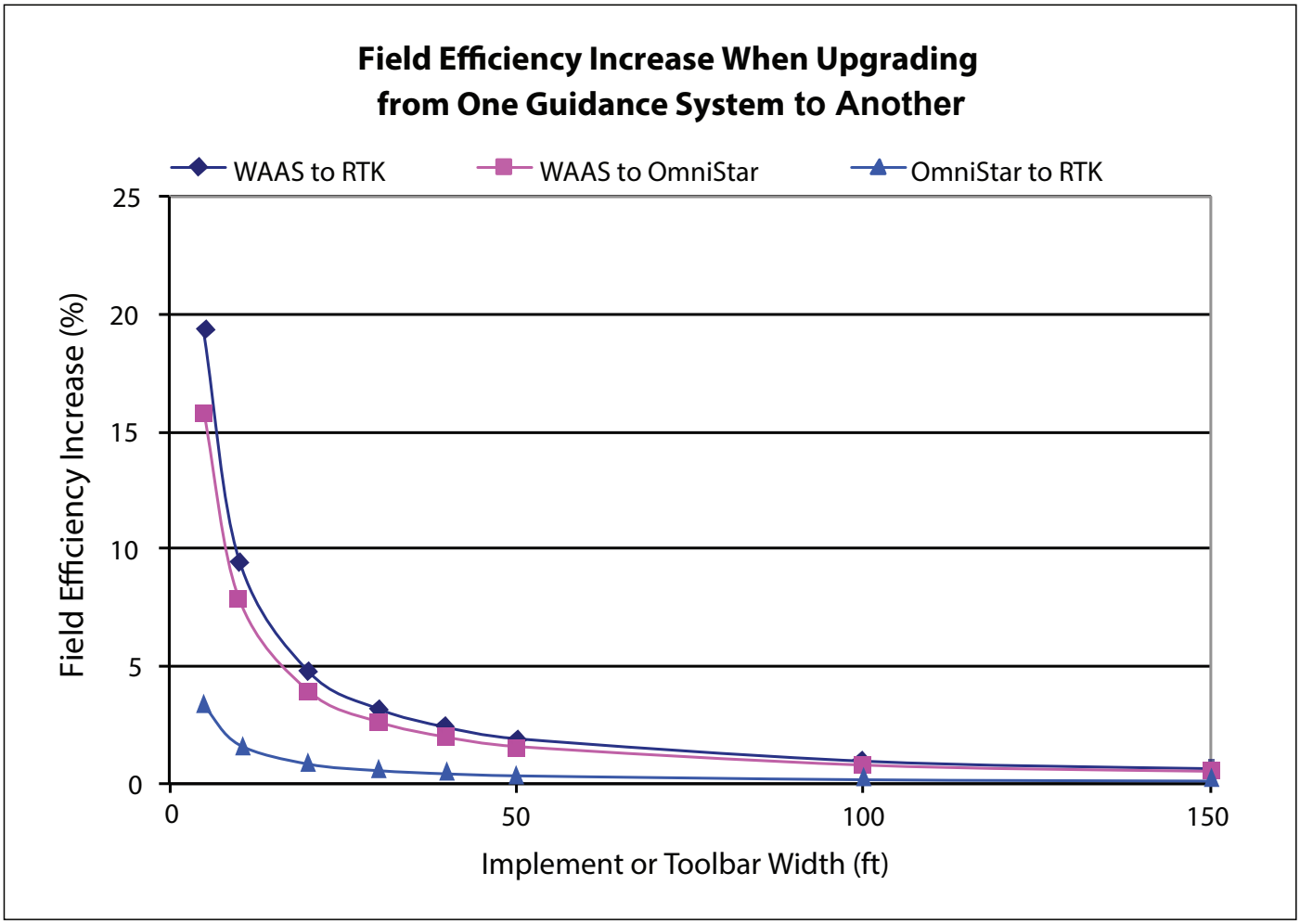

Figure 2. Expected field efficiency increase when upgrading from one guidance system to another.

if an operation normally takes 4 hours to perform, the addition of a guidance system over an unaided driver would yield an 18-minute reduction in time, taking only take 3.7 hours [7.5% (or 0.075) × 4 hours]. Differences in these numbers are sometimes small, but can add up quickly over multiple fields and operations.

Equation 1 can also be used to calculate the benefit from selecting one guidance system over another, and these values are plotted in Figure 2.

Note that the RTK and OmniStar systems give increased FEI values over the WAAS system for smaller toolbar widths, but become less significant as toolbars become wider (such as sprayer booms, etc.).

Correct Overlap Setting: Make sure to input the correct overlap settings into your guidance system. Setting this parameter incorrectly can result in reductions in field efficiency by up to 50 percent or more. For instance, if a WAAS overlap setting (12 inches) is used in a guidance system with RTK accuracies (which is capable of 3- to 4-inch overlap control), the field efficiency would be 30 percent less on a 40-foot toolbar. Also if some operations can afford small skipped or missed areas in the field (such as underground wing tillage tool), you can increase your FEI number even further by running an overlap value that is less than that rated for the guidance system. You should perform testing on each guidance system to determine the smallest value of overlap for that unit that will give you the desired results.

Conclusion: Guidance systems are highly recommended in any farming operation to increase field efficiency and can increase those field efficiencies up to 10 percent. Generally, purchasing the highest accuracy system you can afford will give you the highest FEI for all farming operations, but for specialized farming operations (such as sprayers, etc.) the lesser cost of a WAAS-type system may be nearly as advantageous as a much higher cost RTK system. Some operations such as mowing, rototilling, or small-width horticulture type operations may require RTK-type accuracies.

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