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Engineering Success

A newsletter from Biosystems and Ag Engineering Extension

Harvesting High Quality Wheat

By: Randy Taylor, Michael Buser and Carol Jones

Combine adjustment can affect wheat quality in two fundamental ways: grain damage (cracked and broken kernels) and foreign material. Damaged grain and foreign material make wheat harder to handle, generate dust, and contribute to storage problems. During storage, excess foreign material provides a more favorable environment for mold growth and insect infestation. It also makes it more difficult to properly aerate grain (See Extension Fact Sheet BAE-1101 Aeration and Cooling of Stored Grain Fact Sheet). Some damaged grain may remain in the bin, but a high portion will probably exit the back of the machine in the form of flour and small fragments. Generally, grain damage can be limited to 0.5 to 2 percent, but it can be much higher.

Grain damage occurs mainly in the threshing area of the combine, but can also be caused in the clean grain conveying system. In hard threshing wheat, there is a trade-off between thorough threshing and grain damage. An operator may not be able to completely thresh the crop without causing damage. Grain damage is usually caused by excessive cylinder/rotor speed. If slowing the cylinder/rotor speed doesn't improve the grain sample, adjustment of the concave clearance may be needed. Remember, combine capacity is affected by these two adjustments.

Foreign material and dockage also contribute to a lower quality wheat sample. Weed seed like cheat and downey brome are difficult to separate from wheat. However, harvesting cheat infested fields last can help since drier cheat is easier to clean from grain. Also yield in "cleaner" fields is probably higher,

which makes them more important. Some general adjustments for cheat infested fields are:

1. set chaffer toward open end of recommended range,
2. set sieve toward closed end of recommended range, and
3. set fan toward high end.

Following these guidelines will probably cause returns to increase, so keep an eye on machine capacity to avoid plugging.

Watch your field travel patterns when dealing with cheat. The combine is a serious threat to spread weed seed. It typically takes more than one minute to fully discharge cheat from a combine. If the combine is cutting cheat along the edge of a field, it can carry the seed 200 yards or further into the field.

Correcting Your Losses

Since there are many factors that can create combine losses, an organized approach to correcting the problem is needed. The flow chart on the second page of the fact sheet linked below, shows a procedure for pinpointing and correcting the cause(s) of the lost grain. When fine tuning a machine, try to change only one thing at a time so the effects can be seen. Keep referring to the operator's manual; it seldom pays to deviate very far from suggested settings. If separator losses are less than 1.5 percent, fine tuning is unnecessary.

This text is from OSU Fact sheet L-341. A flow chart to guide you through possible combine adjustments that may help you obtain higher quality grain can be viewed, along with the fact sheet, at http://www.agmachinery.okstate.edu/GrainHarvesting/L-341.pdf

GPS Guidance Information for Pasture Operations

By: Wesley Porter, Extension Associate Engineer, Precision Agriculture Technology

In today's world rapidly changing technology is prevalent in most industries, including agriculture. The use of Global Positioning Systems (GPS) and computer control systems are an ever growing and changing market.

Most individuals are attached to some type of GPS device in their daily lives, whether it is in their cellphone or their vehicle navigation. With so many different devices to choose from how does one decide which is best for specific farming applications and budgets? There are many types of GPS correction signals available. The correction signals will take the raw GPS signal and transfer it into a more accurate and usable signal.

This article includes a review of GPS correction types and uses with most of the basic GPS systems and their intended/best uses with an emphasis on entry-level guidance systems.

GPS Devices

There are many GPS devices on the market and this section is a brief introduction to these devices and reasons why they are or are not acceptable for agricultural uses. The most popular device used is the cellphone, specifically "smart phones". There are many GPS applications available for these phones. These "apps" are decent for mapping points, paths, or boundaries; but are not good for guidance aids. They do not have the capability or accuracy to act as a guidance aid since their typical accuracy is ±50 feet.

The next very popular device is the portable vehicle navigation system. These systems work well on roads because a pre-loaded road map with the road locations is on the device. These devices work with a distance weighted algorithm to find the shortest and/or fastest path by following roads only—in most cases, I know we all have had these devices lead us to a dead end road, or to the middle of nowhere. It is much easier to find something with a pre-loaded map than to set up swaths in a field. The accuracy of these devices is also in the range of ±50 feet.

Another popular GPS unit that is good for recreational use is the handheld units you can find at most any sporting goods store for a cost range of \$100 to \$500. These handheld units are great for marking points and paths and navigating back to them. However, they do not have the capabilities or accuracy (±15 feet) to act as a guidance aid.

If you can obtain a handheld or field computer, you can install an agricultural based program which can be linked with a GPS unit to be used for mapping, coverage area, and system control. This setup can work well in most instances however it is not meant as a guidance aid.

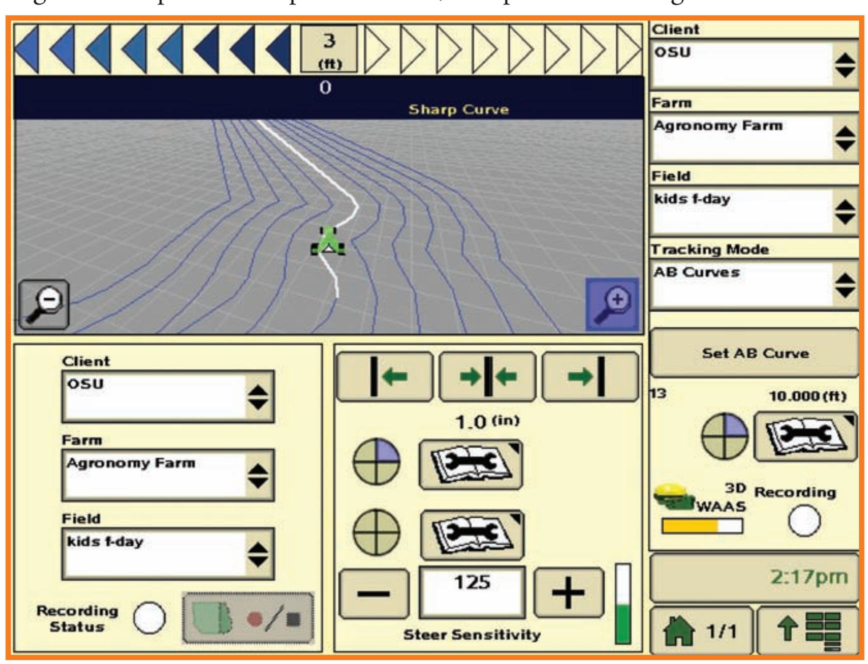
Entry-Level Guidance Systems

Manual steering is usually required for entry-level systems. The most common system is a lightbar system that aids agricultural machine operators in steering along uniformly parallel passes across a field. Most lightbar systems include a Differential-GPS (DGPS) receiver (can increase the accuracy to sub-foot in many cases), an antenna, some sort of computer or microprocessor, and a lightbar or graphics display.

Lightbars: Operation, Set-up, and Benefits

To operate a lightbar system, the operator must input basic machine/implement parameters, such as width and the agricultural operation being performed. Then the driver begins by steering the first pass through the field and selecting an "A-B" line by pressing a button at the beginning (A) and end (B) of the pass. The computer records the location of the two points and uses the implement width to determine the location of each subsequent parallel pass across the field. The operator must perform the head land turns and position the vehicle close to the next swath. The actual vehicle location is compared to the calculated paths created by the computer based on GPS location. The error and direction to the nearest line is displayed so the operator knows which way to steer the vehicle to remain on the desired path.

The simplest lightbar displays are made of a single horizontal row of lights. The center light, which is sometimes a different color or shape, indicates the "guidance path". As the vehicle deviates left or right of the path the lights are turned on to represent the path location, as represented in Figure 1. The



Be sure to check http://www.agmachinery.okstate.edu/ for new fact sheets about these technologies.

goal is to keep the vehicle on the center path. The display will usually indicate the error in an offline distance so the operator knows how far off of the intended path they are. There are many variations in lightbar displays. Some have a single row of lights, as shown in Figure 1, while others may have two rows of lights. Certain systems have LCD display screens with 2-D representations of the field and guidance paths.

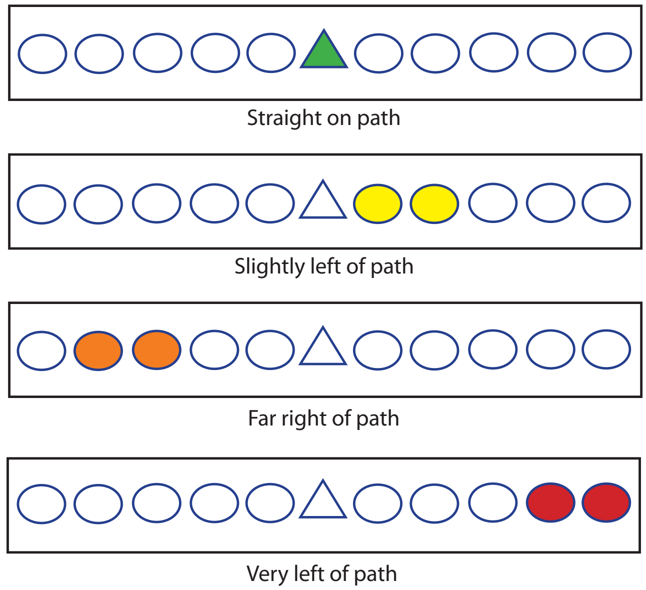


Figure 1. Examples of lightbar guidance displays.

Some of the earliest systems were only able to create straight parallel swaths. However some of the modern systems have the capabilities to guide along curved paths, along with other various field patterns such as contour strips, irregularly shaped fields, and circular patterns for center-pivot irrigated fields.

The lightbar guidance paths are independent of any obstacles in the field, thus you must be alert because the system will not warn you of any obstacles. This means if you have a tree, terrace, hole, or any other obstacle you can drive around it and still line back up on your path. In some of the newer units especially the ones with LCD displays you can mark these obstacles so they will be displayed on your unit in the field, and possibly worn of your approach to them.

The primary advantage of using a lightbar is a reduction in application errors such as overlaps and skips. Recent studies have shown that most operators who use foam markers with chemical application will overlap nearly five percent of the machine width on each pass. Lightbars can help reduce overlap to less than three percent without increasing skipped areas. This can translate into a reduction in chemical use as much as two percent.

Lightbars can also improve machine operation in poor visibility. Glare during sunrise and sunset hours can make it difficult to see markers and references while the lightbar will be easily visible. Cover crops can also make subsequent passes difficult to see while the lightbar will improve this problem.

Lightbar guidance aids can help in reducing driver fatigue just due to having the "guidance aid" being right in front of the operator rather than out in the field somewhere allowing the operator to focus more on driving rather than looking for row markers. This also allows the operator to focus more on other machine functions and displays.

A majority of the lightbar systems will record the path of the machine through the field, and some will also record a coverage path indicating whether the machine was applying or not. This can be a valuable resource of records for producers knowing exactly the amount and location of where inputs were applied along with the time of application.

In conclusion, there are many GPS devices available on the market with prices ranging from nearly $50 and up into the thousands of dollar range. Each one of these devices has its intended and specific use which it will function well at. However, you cannot use most of the devices in a farming situation, especially as a guidance aid.

For an "entry-level" guidance operation, lightbars are an excellent choice because they are low cost technology that can bring many advantages to farming operations.

Previous page: This screen capture is of the John Deere Greenstar system and shows a good representation of how curved paths can be used to navigate around obstructions in the field. ***This page, left:*** This is a typical lightbar with LED's as the main reference; it is a very simple system and is on the cheaper end of the price range. ***This page, middle:*** The Raven Cruizer is an example of a lightbar with an LCD display screen with coverage path and area logging capabilities. ***This page, right:*** The TeeJet Centerline is a good example of a lightbar with an LED guidance path along with a user display for more information.

Better Data Leads to Revised Lagoon Standard

By: Doug Hamilton, Extension Waste Management Specialist

The American Society of Agricultural and Biological Engineers (ASABE) recently revised Standard ANSI/ ASAE EP403.4 -- Design of Anaerobic Lagoons for Animal Waste Management. This is the first substantial revision to the standard since 1986. The most important changes were to the sludge accumulation factors for swine and poultry manure treatment lagoons. The current factors for all types of manure are given in Table 1. Accumulation rates for pullet and layer farms were combined into one poultry factor. The new combined value is 12 percent higher than the old pullet rate and 28 percent lower than the old layer rate. The accumulation rate for swine lagoons was reduced 55 percent.

Although small on paper, these changes could greatly alter the design of manure handling systems used by pork and poultry producers. Let's step back and look at how lagoons function.

A lagoon is a large, earthen basin used to treat and store organic liquids and slurries. Lagoons are divided into three volumes stacked on top of each other – sludge storage, treatment, and effluent storage (Figure 1). Freeboard (empty storage space) above the effluent storage protects the lagoon embankments from overtopping during storms.

Organic solids settle to the bottom of the lagoon, and are digested at the top of the sludge layer. Further treatment takes place in the liquid portion of the treatment volume. The treatment volume is sized using a volumetric organic loading rate – the daily amount of organic matter fed to the lagoon, divided by the treatment volume. The design rate depends on a number of factors -- chiefly the desired level of treatment and climate.

When a lagoon is brand new, the liquid volume available for treatment is equal to the treatment volume plus the sludge storage volume. But as solids break down and become sludge, the sludge layer grows and the liquid volume above it shrinks.

As seen in Figure 2, it is hard to find a sludge layer at all during the first year or so after manure is added to the lagoon. Then, sludge suddenly appears, and growth is rapid for the next 3 or 4 years. After about five years, accumulation slows to a steady rate. Once the liquid volume reaches a critical level, sludge accumulation accelerates again, and the lagoon quickly fills with sludge. The treatment volume is sized so that the critical value occurs after the design organic loading rate is reached.

Lagoons are designed to reach their design organic loading rate in 15 to 20 years. How large a volume is set aside for sludge storage is determined by the sludge accumulation factor. If the standard accumulation rate is increased, as it was for pullet farms, the required sludge storage volume increases. If the rate is reduced, as it was for swine, design sludge storage is smaller. Smaller sludge storage means smaller lagoons. Larger sludge storage means larger lagoons. Construction cost is partially dependent on lagoon size.

The standard accumulation factors shown in Table 1 imply that sludge growth is linear, but a number of studies leading to the sludge accumulation model shown in Figure 2 confirm that growth is not linear. Does not mean that the standard is wrong? No. If the stable growth stage lasts a long time, accumulation over the long haul appears linear. And with a 20 year design life, steady growth should last at least 15 years. The values given in Table 1 are linear approximations of the complex curve.

The microbes living in lagoons do not know or care about changes in standards. They will continue to digest solids the same as they always have.

A long term study of lagoons conducted in Oklahoma uncovered an interesting fact. Lagoon microbes do not like to be bothered. Contrary to what you might think, removing a little sludge every year actually makes the sludge accumulate faster. The factors given in Table 1 are based on undisturbed sludge. Mess with the sludge blanket, and the lagoon may fill up long before 20 years have passed.

	Sludge Accumulation Factor	
Manure Type	**m^3 sludge/kg TS added**	**ft^3 sludge/lb TS added**
Poultry	0.00202	0.0324
Swine	0.00137	0.0219
Dairy	0.00455	0.0729

Table 1. Sludge Accumulation Estimates (from ANSI/ASAE EP403.4 -- Design of Anaerobic Lagoons for Animal Waste Management).

To learn more about lagoon function and design, check out the revised OSU Fact sheet BAE-1736, Lagoons for Livestock Waste Treatment. To review research on sludge accumulation conducted right here in Oklahoma, read Transactions of ASABE. 53(2):529-536: Sludge Accumulation in Two Anaerobic/Facultative Lagoons Treating Swine Manure from Breeding Farms in Oklahoma. Both can be found at the **Waste Management Engineering website, http://osuwastemanage.bae.okstate.edu.**

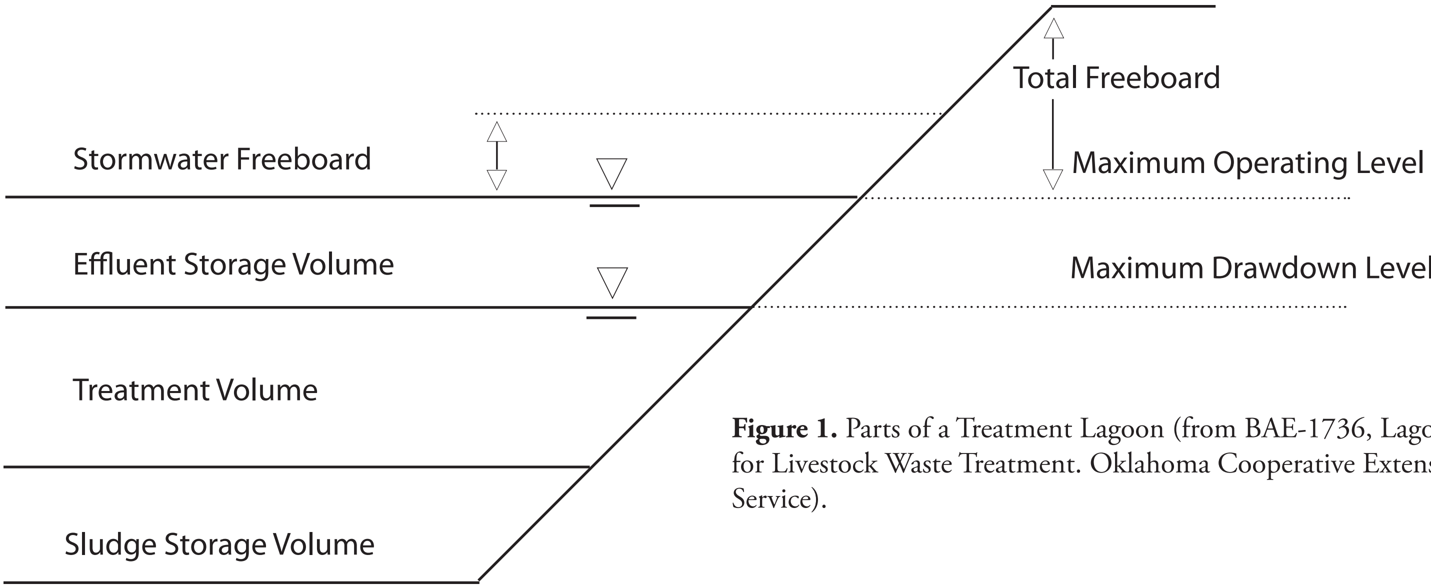


Figure 1. Parts of a Treatment Lagoon (from BAE-1736, Lagoons for Livestock Waste Treatment. Oklahoma Cooperative Extension Service).

The pictures above are of lagoons used in a long-term sludge accumulation study in Oklahoma.
Picture at left: Lagoon OK1 located near Tecumseh, OK. ***Picture at Right:*** Lagoon OK2 located near Poteau, OK.

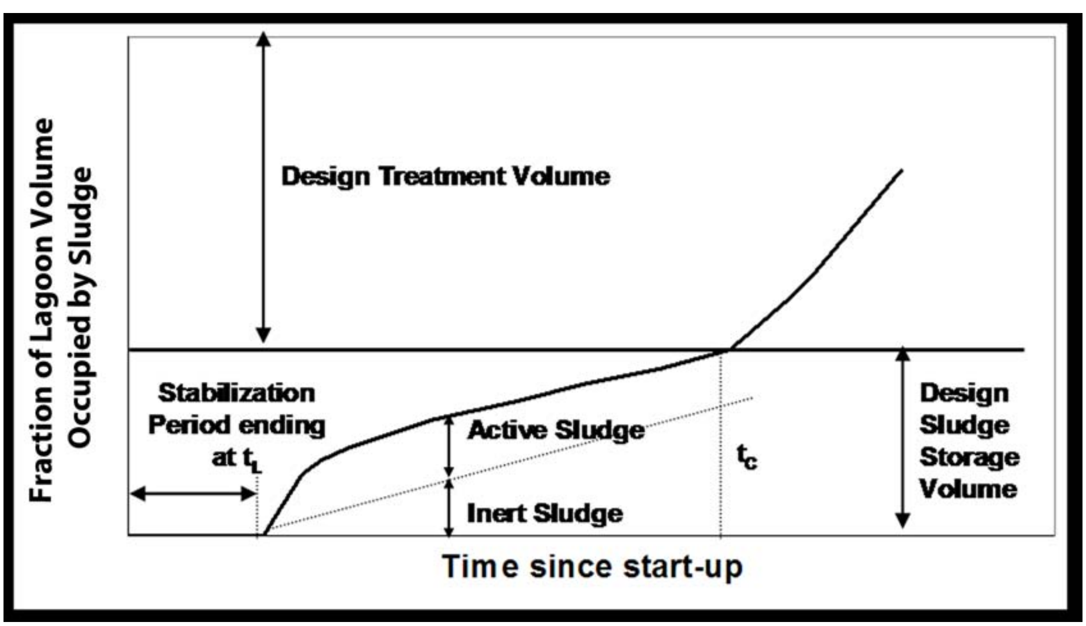


Figure 2. Complex Sludge Accumulation Model (from Hamilton, D.W. 2010. Sludge accumulation in two anaerobic/ facultative lagoons treating swine manure from breeding farms in Oklahoma. Trans. of ASABE 53(2):529-536).

Saving Diesel During Field Operations

By: Randy Taylor, Extension Machinery Specialist

The high price of diesel fuel is a concern to many farmers in Oklahoma. Following the upcoming wheat harvest, many farmers will be in the fields with tillage operations. While the easiest way to save fuel is to remove a tillage pass, this may not be feasible for many farmers. Another option is to be as efficient as possible with the tractor. To provide tips for improving efficiency, Iowa State University recently released a new fact sheet covering an old topic: Shift Up – Throttle Down. The basic concept has been around for many years, but now is a great time to relearn it. If the tractor is under partial load, you shift to a higher gear and reduce throttle setting so that the ground speed is the same. Tractor engines generally use less fuel at lower engine speeds.

View the new fact sheet at http://www.agmachinery.okstate.edu/tractors/FarmEnergyShiftUpAndThrottleBackToSaveTractorFuel.pdf.

Subscription request

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