

Department of Biosystems Engineering, Auburn University, AL 36849-5626

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Calibrating Equipment with Variable-Rate Technology

One item often overlooked is the calibration of application equipment controlled with variable-rate technology (VRT). Currently, no standard procedures exist for calibrating VRT. While calibration of spreaders, planters, and sprayers is needed for uniform application, it is even more critical to calibrate VRT controlled equipment. In a few cases, traditional calibration procedures could work but do not ensure proper operation over the expected range of varying application rates. *The goal of calibration is to minimize application errors so target rates can be achieved with a certain level of confidence.* The following details suggestions on how one might calibrate equipment with VRT.

Safety

First and foremost, be safe when calibrating equipment due to the nature of the materials being handled. Carefully read all warning and caution labels found on the containers of agricultural chemicals and products being used. For sprayers, it is recommended to only use water in the system unless the spray mixture output rate varies more than 5% from the output rate of water. For planters and spreaders, wear the necessary safety attire as recommended by product manufacturers.

Ground Speed Radar – VRT usually relies on either ground speed radar (GSR) or a global positioning system (GPS) receiver as input for actual ground speed. If a GSR is used, **yearly calibration** of this sensor is important so the variable-rate controller will properly adjust application rates with ground speed variations. An improperly calibrated GSR will lead to application errors. Read either equipment or GSR literature for the proper calibration procedure. Typically, it is suggested to use a 400-foot run on level ground during GSR calibration. A second pass can be used to double-check the calibration.



(a)



(b)

Figure 1. Illustration of Ground Speed Radar (a) and a course laid out for calibration (b).

Expected Application Range

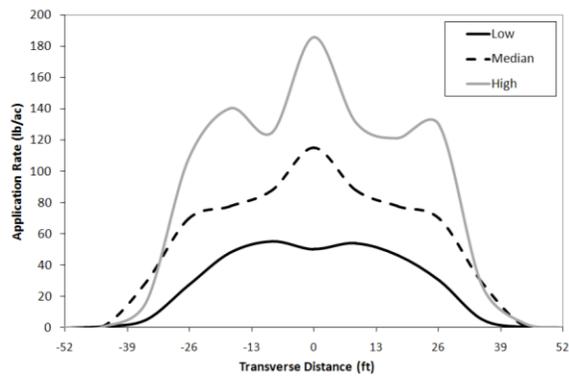
Prior to calibration of equipment with VRT, one must determine the range of planned application rates for the product(s) to be used during VR application. This range will be used to ensure that the software and hardware setup will properly operate over the expected range of rates once an acceptable setup is determined during calibration. For example, you might decide to vary your corn seeding rates from 24K to 36K seeds/ac. Knowing this information, select the median rate (30K) to start calibrating the planter equipped with VRT.

Pre-Calibration Checks

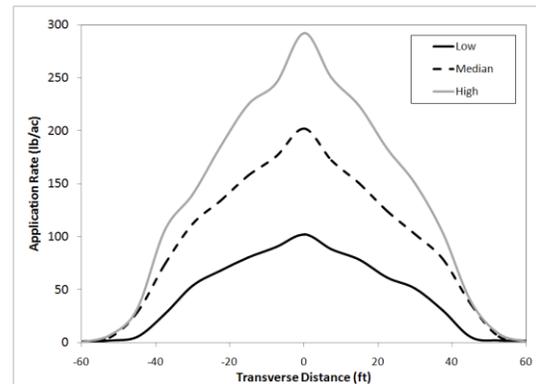
- Make sure all hardware and software are in proper operating condition. Replace any worn hardware, especially those controlling the metering and distribution of material.
 - **Granular / Dry Applicators:**
 - For spinner spreaders, this includes the divider, spinner-discs, and especially the spinner fins.
 - For pneumatic applicators, check the metering mechanism, fan, tubes, and deflectors. Worn tubes can have an impact on material transportation to the deflectors while worn deflectors can impact distribution.
 - **Sprayers** - select a nozzle that is capable of handling the expected application rates, spray pattern, ground speed, and pressure.
 - **Planters** – check all drives and individual metering element(s) on each row unit.
- Ensure that the tank/bin is at least half full.
- If rates are going to be varied over a wide range, especially for lime application, check the distribution pattern at the **median rate** followed by a check at the minimum and maximum application rates. This procedure will ensure proper distribution over the range of desired application rates. If a distribution issue exists, the rate variation should be limited to a smaller range.

Calibration

- **Follow manufacturers' recommendations.**
- **Calibrate annually.**
- Watch for **pattern shifts** especially for spinner spreaders (Figure 2a).
- **Dry Product Density:** If the intentions are to use variable-rate blended products, then make sure the products have similar density and particle size. It is not advisable to blend products if these differences exist since pattern uniformity will be greatly affected over the range of application rates. This issue is more important for spinner spreaders than pneumatic applicators.
 - Perform individual distribution tests for different granular products especially if they have different density and particle sizes.
 - For example, potash will require a different calibration than lime.
- **Sprayers:**
 - Take any pressure readings at the boom.
 - Ensure nozzles are within 5% of the manufacturers operating specifications.
 - If the spray mixture is significantly altered by the addition of adjuvants, it is recommended to compare the output mixed rate to water and ensure that the values are within 5%. If 5% exceeded, calibration must be conducted utilizing the spray mixture.
- **Planters:** Ensure proper seed drop and that the planter settings/configuration can cover the range of expected seeding rates (Figure 3).



(a)



(b)

ISSUE: Existence of pattern shifts. A slight W-pattern at the low rate but shifts to an M-pattern as the rate increases.

DESIRED: No shifts observed. Symmetric patterns over the expected application range.

Figure 2. Distribution pattern results for a spinner spreader; a) undesirable pattern shifts and b) desired symmetric patterns.



Figure 3. Planter calibration ensuring proper seed drop.

If the *application range is too broad for the setup*, then application at the upper and lower rates may deviate too much from the desired application rates and therefore generate application errors. For example, at planting, you plan to vary the seeding rates between 0 and 50,000 seeds/acre. The error in the 1-10,000 and 40,000-50,000 densities may be very high. Therefore, it is beneficial to narrow the range as much as possible based on the predetermined application rates. Along with a narrowed range, results can also be improved by conducting calibration at the median rate, or the most utilized rate. Once the VRT component is calibrated, the upper and lower rates of the narrowed range should be checked to ensure that calibration is between 5% and 10%.

Additional Information

Also see ACES Timely Information Sheets:

- Introduction to Prescription Maps for Variable-Rate Application (January 2009)
- Calibrating Equipment with Variable-Rate Technology (January 2009)
- Overview of Automatic Section Control Technology (July 2008)
- Precision Soil Sampling for Alabama Farmers (January 2007)

Prepared by

John Fulton, *Assistant Professor and Extension Specialist*, Christian Brodbeck, *Research Engineer*, Ted Tyson, *Professor*, Biosystems Engineering Department, Auburn University, and Amy Winstead, *Regional Extension Agent*, Shannon Norwood, *Multi-County Extension Agent*, Alabama Cooperative Extension System.