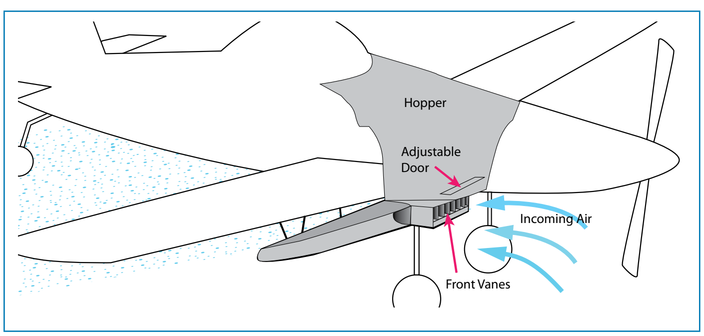
Spreader Setup for Aerial Application

Spreaders are attached to agricultural aircraft and used to distribute seeds, fertilizers and dry chemical products. The first time an airplane was used to treat crops was in 1921 when a U.S. Army pilot applied insecticide to Ohio's catalpa trees infested with moth. Since then, agricultural aviation has proven to be a fast and efficient form of product application to our crops.

The most common spreader used in agricultural aviation in the United States is the venturi or RAM spreader. Venturi spreaders clamp to the gate box at the base of the aircraft's hopper. The gate boxes are 25, 38 or 41 inches wide depending on the size of the aircraft. As the adjustable door (gate) on the gate box opens, material from the hopper falls into the venturi spreader, and it is distributed by the airflow through the spreader. The opening of the door determines the flow rate. Some of the limitations on venturi spreaders include high aerodynamic drag, high power requirements and low quality pattern of distribution for high application rates (greater than 250 pounds per acre).



Details of a venturi spreader

The venturi spreader is composed of ducts, also called vanes that can vary in number from five to 13. Each vane has adjustable sections at the front or rear. Adjustments on the front portion of the vane modifies the amount of material and air that moves through it. Adjustments of the rear section of the vanes may change the initial path of the material leaving the spreader.

As an aerial applicator your job is to deliver product (fertilizer, seeds, etc.) on time, with great quality and precision. Major concerns to applicators are swath width, uniformity and operation efficiency. How the spreader is mounted (attitude), the rate of application and variations in the material's physical properties have major effects on swath width and uniformity of application. Larger swath widths will increase operation efficiency (acres per hour), a "must-do" today with the increasing operational costs.

Front Vanes Adjustment

Most venture-type spreaders have adjustments for inlet vane position. These adjustments can be done during a calibration clinic to fine-tune and achieve uniform depositions. Adjustments are usually a trial-and-error process, but, in general, air movement generated by the propeller cause material to be pulled from the right part of the aircraft and deposited to the left side of the aircraft. Almost all aircraft require that extra material is directed to the right side of the aircraft to compensate for this. Inlet vanes should be moved to the left side of the spreader to remove material and redeposit it on the right side.

Rear Vanes Adjustment

In most cases, a uniform deposition is achieved without the need of rear vane adjustments. They should be adjusted only when all front vane adjustments are exhausted. Moving rear vanes changes where material is deposited. The primary function of the rear vane is to change the exit direction of particles.

Spreader vanes should be kept clean. Obstructions such as wet fertilizer and oil inside spreader vanes will affect the spread pattern.

Spreader Mounting

When mounting the spreader, the objective is to minimize drag, reduce turbulence and achieve maximum swath width and application rate capability. Spreaders should be leveled from side to side under the airframe (roll axis of the aircraft). Spreaders should also have zero degrees of yaw in relation to the aircraft. The front-to-rear angle of the lower edge of the spreader should enhance air movement through the spreader. In general, the attack angle of the spreader's lower surface should be between 1 to 3 degrees less than the attack angle of the bottom surface of the wing. If the spreader tail is too low, turbulent air flows from the underside creating extra drag and slowing material movement.

Gates

Many pattern problems discovered during calibration clinics are caused by uneven gate adjustment. Gates must feed evenly across the entire opening. This is of particular importance for lower application rates, such as the ones used with hybrid rice varieties. There is not an easy way to check gate opening. Many applicators put some material in the hopper and, while a second person operates the handle and opens the gate slowly, check for evenness and uniformity of the material coming out of the gate.

Application Altitude

Optimal altitude for material distribution should be anywhere between 40 to 60 feet and depends on application rate, material and the spreader. For application during windy conditions, best distribution patterns are obtained when spreading at a 45- to 90-degree angle from the wind direction.

Swath Width and Application Rate

Swath width and application rate depend on one another. Higher application rates usually come associated with smaller swath widths because as the stream of particles exiting the spreader becomes heavier it also becomes less prone to break up. In general, there is a relationship between application rate and swath width that observes a 25:3 rule: for an increase in application rate of 25 lb/ac the swath width should decrease 3 feet. For example: if 100 lb/ac is obtained with swath width of 60 feet, to obtain 125 lb/ac the swath width should be 57 feet.

Guidance Systems

Global Positioning System (GPS) sensors have become the standard equipment for obtaining positioning information in several industries, including agricultural aviation. GPS offers several advantages over traditional forms of guidance and ultimately needs to be faced as a necessary step in the evolution of guidance systems and application equipment. GPS-based guidance systems offer unparalleled quality during application and help pilots to avoid overapplication and skips. With the aid of a GPS system, pilots record pertinent information such as coordinate location during application, application speed, etc. This information can be very important for operation documentation and customer service feedback.

Variable-rate Application (VRA)

Variable-rate application (VRA) is a technique often used by progressive farmers in which different product rates are applied in the field in an attempt to match varying field requirements according to features such as soil type or field topography. Farmers and agricultural consultants work together to develop variable-rate maps. Computerized systems for variable-rate application of dry material are available for agricultural airplanes. These systems automatically adjust gate opening during flight, releasing more or less material according to a prescription map, ground coordinates and aircraft speed. The system also can be used to adjust material release based on aircraft ground speed, offering a precise single-rate application. VRA may be a great option for farmers wishing to apply precision-farming technology to their fields, and it may offer aerial applicators the opportunity to add value to their services, therefore enhancing their level of customer service.

Calibration Clinics

The LSU AgCenter offers calibration clinics to aerial applicators who desire to fine-tune their spreaders. These clinics are usually held early in the spring before the season starts. During the clinic, application swath width and rates are analyzed with specialized equipment as suggested by the National Agricultural Aviation Application Association (NAAA). Uniformity of application, as defined by a low coefficient of variation (CV), produces less crop streaking and avoids yield reductions.

Airplane participating in a calibration clinic.

Author:
Roberto Barbosa, Ph.D., Assistant Professor
Department of Biological and Agricultural Engineering

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Louisiana State University Agricultural Center
William B. Richardson, Chancellor
Louisiana Agricultural Experiment Station
David J. Boethel, Vice Chancellor and Director
Louisiana Cooperative Extension Service
Paul D. Coreil, Vice Chancellor and Director

Pub. 3078 01/09