7 – Chemical Applications

Dennis Gardisser

Rice yields are enhanced through the use of agricultural chemicals – both fertilizers and pesticides. Factors such as chemical selection, timing and application accuracy can enhance the efficacy and increase the economic return of these inputs. A variety of application techniques are used to apply chemicals to rice. Early season chemical applications are generally split between ground-based and aerial platforms. For rice, the primary application tool, once the field is flooded, has been the agricultural aircraft.

Global Positioning Systems (GPS) or satellites have been used for a number of years to provide guidance for chemical applicators. GPS is a very accurate method to follow a prescribed path in the field for each pass. Thus, flaggers are no longer needed, and the GPS provides a logistical value to applicators. Chemical applications can be made to fields at any time without having to coordinate the exact application time. Many of these GPS also have the ability to track the application operation, which provides an excellent record of the many application variables.

Pesticides

Ground-Based Soil Applications

Many growers use ground equipment to apply pesticides before planting and flooding. The focus of most chemical applications centers around application dosage accuracy, swath uniformity and drift minimization. Almost all nozzle manufacturers offer a table-based guide to assist applicators with the correct nozzle selection for each type of chemical used. These should be studied carefully to determine which nozzle type and setup will provide the best performance. Many nozzle manufacturers offer excellent web-sites with selection and calibration information. Examples include www.teejet.com, www.greenleaftech.com and www.sprayparts.com.

Many manufacturers are using an air induction type nozzle to help control droplet size – particularly to reduce the number of fines or small droplets that are produced. Proper selection of air induction type nozzles helps keep the droplet size within the desired range. Most ground-based pesticide applications should perform well with droplet spectrums that provide a VMD (volumetric mean diameter) in the range of 500 to 1,000 µm. One micrometer is 1/25,000 of an inch – the diameter of a human hair is ~ 100 µm.

Larger droplets (500 to 1,000 microns) are typically used for ground contact applications because coverage may not be as critical. Applications on leaf surfaces should be targeted for droplet spectrums in the 300 to 500 µm range. Nozzles on large floater trucks that are used for liquid fertilizer applications typically make a droplet size too large for adequate performance when applying to plant surfaces. Fertilizer type flood nozzles may even produce droplets that are too large for soil-applied pesticides and should be used with caution. Carefully study the data available and select the best suited nozzles. Manufacturers typically offer bar graphs that help with selection based on chemical mode of action.

Aerial Soil Applications

When the soil gets wet and everyone gets in a hurry, many pesticide applications are done by agricultural aircraft. Aircraft are commonly used for burndown herbicide applications. Aircraft are an excellent spray platform. Development of new nozzle technology and performance evaluation

techniques has allowed pilots to customize the aircraft to increase application efficiencies.

Spray pattern uniformity, droplet size and application dosage should be carefully evaluated with all types of sprayers. New GPS feed rate controllers allow applicators to maintain application spray rates within ±1 percent of the target rate. This technology is becoming more common. Estimates are that at least 10 percent of the Arkansas aircraft fleet has rate controllers.

Ground-Based Postemergence Applications

Ground-based postemergence pesticide applications to flooded rice fields can be difficult. These applications work best when specialized equipment is used or on applications made to precision leveled fields with straight levees.

Typical ground-based application equipment may have problems with traction in the flooded fields and can damage levees to the point that using the equipment is impractical.

Aerial Postemergence Applications

Some postemergence pesticides are applied in a granular form (i.e., Ordram® and Facet®). These materials are generally applied at rates of 15 to 30 pounds per acre. Agricultural aircraft spreaders are typically designed to make applications at rates of 100 pounds per acre or higher. Spreaders can be set to make these lower application rates, but attention to setup details is more critical. These materials can be distributed quite accurately when aircraft are properly adjusted.

Fertilizers

Ground Applied

Spinner Units – Many applications are done prior to flooding using trucks and/or buggies with rotating spinner applicators. These units may do an excellent job of spreading, but they need to be adjusted carefully for the various application rates and material types used. There is no one setting that will provide a uniform distribution of all materials and application rates.

Spinners should be carefully calibrated and the distribution pattern tested during the off-season to determine gate openings, spinner speeds, blade settings and feed point adjustments that will provide the best field uniformity. Optimum swath widths will also vary – so they should be noted as well during the calibration process.

Swath calibrations are typically done with a set of 11 to 25 pans that are about 6 inches tall and about 15 inches square. A fabric or grid is used in each pan to avoid “bounce out.” These pans are spread out evenly and the unit operated over them normally. The material is collected from each pan, weighed or measured and then graphed to determine swath width, uniformity and application rate. This same technique is used for all types of granular distributors.

Air-flow Spreaders – Air-flow spreaders have the potential to make very uniform applications. The distribution points are typically every 3 to 5 feet. If every point is properly adjusted, these units should be less susceptible than spinner units to variations in distribution pattern due to wind and topography. Care should be taken to keep the metering mechanism clean and in good repair. Faulty or plugged feed delivery systems can play havoc with the dosage that is delivered to each distribution point. A thorough daily cleaning will help avoid this. Units should be operated statically long enough to completely dry all air passageways after cleaning.

Aerially Applied

Most of the nitrogen fertilizer is applied to rice aerially. Aircraft spreaders can do an excellent job, but need to be carefully calibrated to ensure swath uniformity and that the correct swath width is being used. Workshops are held in Arkansas annually to help aerial applicators test and calibrate these spreaders. Measurement techniques very similar to those used on ground equipment are used. The major difference is the size and shape of the collectors. Generally, collectors are constructed on a steel skeleton with a cone-shaped fabric cover. The fabric absorbs the energy from the falling particles – helping to avoid bounce out.

Almost all state agencies and major forestry contracts now require aerial applicators to be tested and provide documentation on performance. This practice is becoming more common with farmer customers as well – to provide some assurance of quality prior to the job.

Aircraft equipment has improved dramatically in recent years. The most common swath width for prilled urea is about 78 feet when using an application rate of 100 pounds per acre. Swath widths typically narrow about 3 feet for each 25 pounds per acre increase in application rate. This is because there is an increased flow rate of material through a fixed air flow in the spreader. Each spreader has a maximum practical limit of material that can be transported with the available air – the intake area of the spreader is generally fixed.

Many spreaders reach a practical limit at application rates greater than 250 pounds per acre. Increasing flow rates above this point generally results in poor pattern uniformity. Applicators typically cut the swath width in half when this limit is reached. This cuts the flow rate in half and provides a second coating of material. Two coats of fertilizer are very similar to two coats of paint – the overall application is more uniform.

Material Property Effects

Ground and aerial applicators do a much more uniform job of spreading seed than fertilizer. This is because seeds are all about the same size and shape – with almost no fines. The most important variable with seed applications, particularly with spinner and aerial spreaders, is

use of the correct swath width. The swath width for seed varies with seed shape, density and size. Optimum swath widths differ very little for aerially-seeded rice. These are typically between 48 and 60 feet, with the higher application rates and smaller equipment being on the low end.

Buying cheap fertilizer may not be a good way to reduce input costs if the fertilizer is not a uniform size. No application platform can uniformly spread materials that have a lot of different size categories. The more fines or dust in a fertilizer mix, the poorer spread pattern one can expect.

Segregation of sizes becomes a major problem with blended fertilizers. Segregation in the hopper may be avoided, or significantly reduced, if proper blending is done and the material is not allowed to cone during a transfer operation. Differences in spread widths of the blended materials will still occur if the individual components vary in size, shape and density.

General Recommendations

Chemical applications represent a large component of rice production costs. Work with your equipment or your applicator to ensure that the most accurate application possible is obtained. Several calibration workshops are held annually around the state to help applicators fine tune their systems. Several publications are available at the county Extension office to aid in selection, calibration, operation and maintenance of all types of sprayers.

References

EL317	Sprayer Calibration
FSA1001	Calibration of Band Granular Applicators
FSA1006	Chemical Applicators – Spraying
FSA1003	Boomless Sprayer Calibration
MP162	Ounce Calibration Card
MP229	Rope Wick Tips
MP230	Calibration for Band Spraying