WHO CALIBRATES YOUR SPRAYER?

University of Nebraska researchers found that only one of six golf courses are accurately applying pesticides. What would they find at your course?

by David Varner, Ph.D., and Robert Grisso, Ph.D.

Last summer, researchers visited 53 of the 60 golf courses of the Nebraska Golf Course Superintendent's Association (NGCSA) and found that only one of six were accurately applying pesticides.

Their calibration accuracy study showed that only 17 percent of the courses applied pesticide carrier volumes within five percent of their intended amount (though this number may be conservative because possible tank mixing errors were excluded).

(Spray equipment not delivering within five percent of the desired pesticide carrier volume should be adjusted and recalibrated according to the *Guide for Private and Commercial Applicators.*)

How bad was it?

The average applicator error was 26 percent. However, the magnitude of errors ranged from a mere 0.1 percent to an alarming 177 percent over-application.

Cooperators who over-applied did so by an average of 19 percent. For a quick estimation of over-application costs, assume an average preventive rate of Daconil 2787 at 4 oz. per 1,000 sq. ft. was used (Daconil 2787 was the most frequently-used pesticide among the study's cooperators at an average of $37 a gallon).

Correctly applied, the cost of Daconil would be $1.16 per 1,000 sq. ft. However, using the average over-application error of 19 percent, the cost of application would be an additional $0.21 per 1,000 sq. ft. These costs escalate when considering the total treated area with multiple treatments throughout the season.

In many turf programs, pesticides are key elements in management programs, but are useful only if applied according to label directions. If not properly used, pesticides may become our worst nightmare rather than a proven management tool as we begin the 1990s.

Over-application may also cause turf damage, excessive pesticide residue, increased potential for human exposure and water contamination through surface run-off and percolation.

Another costly venture

Golf courses are unique in the fact that they are often positioned near residential areas with a body of water nearby, and are designed to attract people for entertainment. This makes awareness and accuracy of pesticide application even more important.

Those who under-applied pesticides did so by an average of 34 percent. This can be just as costly as over-application. Under-application may require additional applications, which increase pesticide, fuel and labor costs.

In addition to quantity of pesticide applied, sprayer performance was evaluated on the quality of pesticide application. Quality of application refers to the consistency of nozzle discharge across the boom. This was determined by measuring discharge measurements from each nozzle along the boom.

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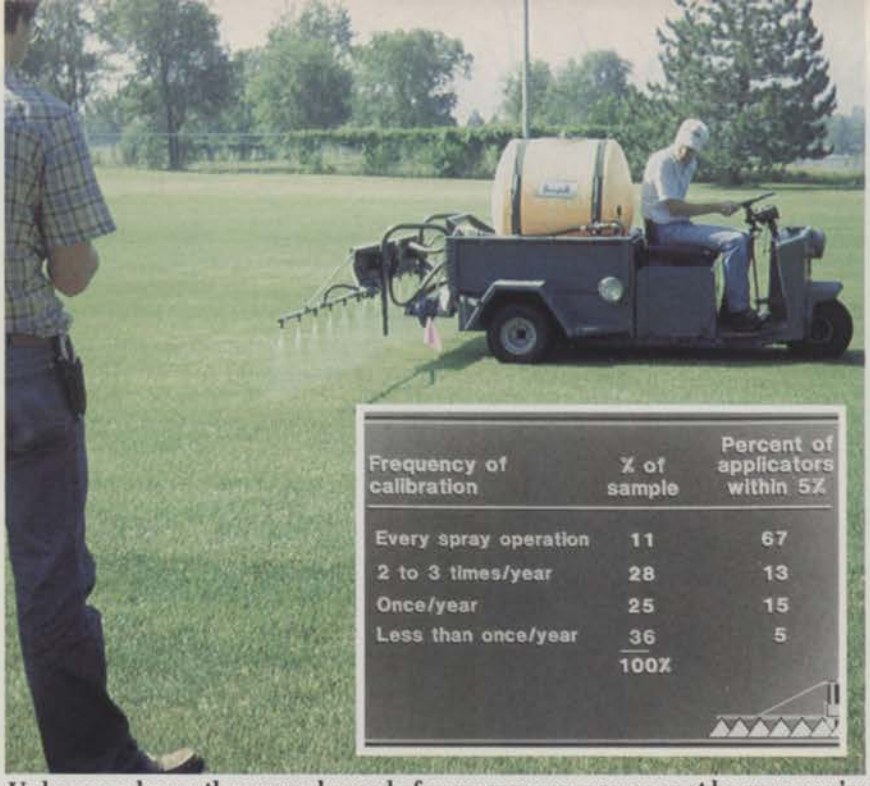
Frequency of sprayer calibration was found to be closely associated with application accuracy. Two-thirds of the applicators who calibrated before each spray operation were delivering within five percent of their intended amount.



Frequency of calibration	% of sample	Percent of applicators within 5%
Every spray operation	11	67
2 to 3 times/year	28	13
Once/year	25	15
Less than once/year	36	5
	100%	

Unless you know the ground speed of your sprayer, you cannot be sure you're not over- or under-applying pesticides. Therefore, accurate, legible speed sensing mechanisms are essential sprayer components.

Eighty-four percent of the cooperators were within recommended guidelines. This suggested that cooperators are maintaining nozzles appropriately. If two or more nozzles were discharging more than 10 percent above or below the discharge average, operators were advised to replace them all.

Researchers found no association between consistency of application and carrier volume accuracy. This shows that it is more important to regularly check sprayers for both types of accuracy.

Frequency of calibration was closely associated with application accuracy. Two-thirds of the applicators who calibrated before each spray operation were within the 5 percent application error criteria. Comparatively, only five percent of those who calibrated less than once a year were within 5 percent. More than one-third of the cooperators calibrated less than once a year.

Calibration methods

The "known area" calibration procedure was the most common procedure used on golf courses. However, only 14 percent of the superintendents employing this procedure were considered accurate applicators.

The most accurate cooperators were those who used spray monitor and controller systems. Sixty-seven percent of these applicators were accurate.

The most common application equipment used on Nebraska golf courses were Cushman Trucksters equipped with Broyhill sprayers, centrifugal pumps and fan nozzle tips. A common problem among sprayers in the study involved pressure gauges showing a system pressure different than the actual nozzle pressure.

Random inspections of pressure consistency among sprayer systems found differences as large as 30 psi. The most probable cause for most of these pressure differences were faulty gauges. Many gauges showed signs of corrosion, had broken crystals, or had a measuring range too large to accurately measure typical operating pressure.

Nozzle problems

Restrictive plumbing systems, which included excessive lengths, inadequately sized and kinked hoses, improper screen sizing and anti-drip devices, were other faults leading to reduced pressure at nozzles.

Educational programs focusing on pesticide application accuracy should continue to address safety concerns for both the applicator and the environment. These programs need to educate applicators to calibrate their equipment and explain why calibration should be mandatory for any individual who deals with pesticide applicators. Applicators need to be certified for their own safety, the safety of their clientele, the general public and the environment.

Learning procedures

Applicators should learn to use one or two calibration procedures consistently to assure regular pesticide application accuracy. Procedures should include measuring and adjusting system pressure, ground speed and nozzle discharge. These procedures should be used before each spray operation. Equipment failure and changing sprayer operations warrant this routine.

Sprayer discharge capacities and pressure gauges should be tested for adequacy and accuracy. Pressure gauges should either be replaced or tested at least once a year.

To increase both awareness and skills in pesticide application, Cooperative Extension offers private and commercial pesticide certification training sessions. Proper sprayer calibration includes the fine tuning of both the quality and quantity of pesticide application. These requirements dictate the proper adjustment of sprayer speed, pressure and nozzle discharge.

Uniformity of application may be increased by using nozzle materials that are more durable than the traditional brass or the economically-priced plastic. Stainless steel nozzles and plastic nozzles with stainless steel inserts have a slightly higher initial cost but last up to four times longer. Excessive losses and over-application of pesticides may be eliminated by using anti-drip devices.

Sprayer system pressure must be

Nebraska study at-a-glance

Who: Nebraska researchers interviewed 53 of the 60 golf course superintendents in the Nebraska Golf Course Superintendent's Association (NGCSA).

What: On-site interviews and sprayer performance tests were conducted to determine how accurately superintendents were applying pesticides.

The results: Only one of six cooperators was found to be applying pesticides within five percent of their intended amount. The average application error was 26 percent, with the magnitude of error ranging from 0.1 percent to an alarming 177 percent.

Eighty-four percent of the cooperator's were within recommended guidelines for sprayer performance. The most accurate applicators were those who calibrate sprayers most often. □

Accurate ground speed is essential

Accurate pesticide application requires that the operator know exactly how fast the sprayer moves over the ground surface. Yet many of the superintendents interviewed were unable to determine this due to faulty equipment or new tires.

Inaccurate speed sensing mechanisms was determined to be a significant equipment problem. In most situations, ground speed was estimated by correlating power take-off (PTO) speeds with driving gears. Many applicators had to guess ground speed because speed tables used with PTO speeds had deteriorated beyond legibility or tires had been replaced with a new size, making the table invalid.

Nearly 63 percent of the cooperators had ground speed errors of more than five percent. This automatically places the cooperator in the inaccurate applicator category unless another factor compensates for the error during calibration.

Because of wheel slippage and rough surface conditions, the actual speed is often different from the tachometer and speedometer readings.

For an accurate measurement of ground speeds less than six miles per hour, mark off a distance of 220 feet. Measure the elapsed time in seconds required for the spray unit to travel 220 feet. The speed is calculated as: mph = 150/seconds timed. If the ground speed is above six miles per hour, mark off a distance of 440 feet and calculate as mph = 300/seconds timed.

—The authors□

maintained within nozzle specifications. Operators outside of this specified range cause spray pattern distortion, accelerated nozzle wear and improper discharge rates through nozzles. It is important to remember that the relationship between nozzle pressure and discharge rate are not linear. In fact, the pressure needs to be increased by almost four times to double the discharge rate.

Using pressure gauges

The pressure discrepancies may be monitored by installing a pressure gauge on the spray boom. This is a very practical way of monitoring the actual boom pressure. The current pressure gauge should also be maintained as a check on the system. Antidrip devices can reduce system pressures by three to five psi, so adjust your pressure to meet nozzle requirements accordingly.

A sprayer monitor or controller that changes system factors or alerts the operator of system changes or problems would be a good investment.

A monitor is a device that measures flow, pressure and speed. It uses electronic sensors for measurements but makes no adjustments. A controller adjusts for various spraying conditions by increasing or decreasing flow or pressure. But be aware that these systems are not infallible. For example, if a nozzle plugs, a controller increases the pressure to maintain flow throughout the system and ignores the blockage from a single nozzle.

Spray equipment will apply pesticides properly if operated and calibrated.

Eyes don't have it

It is not enough to visually inspect sprayer performance. The eye cannot detect differences in the nozzle discharge unit until it nears a 50 percent error. Operator's manuals include tables to show spray volumes for various nozzles, spacings, pressures and ground speeds. Use this information to initially set up the sprayer, then use proper calibration procedures to "fine-tune" the sprayer for accurate application.

Pressure gauges may be tested using a dead weight tester (shown here). Inaccurate pressure readings can cause pattern distortion, accelerated nozzle wear and improper discharge rates (photos courtesy of Dave Varner).

Awareness and accuracy of pesticide application is critical.

Proper tank mixing is also critical. Incorrect tank mixing could make pesticide application errors worse. Remember to read and follow pesticide label directions and safety considerations. Obtain educational materials for training for all personnel using or working around spray equipment. **LM**

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