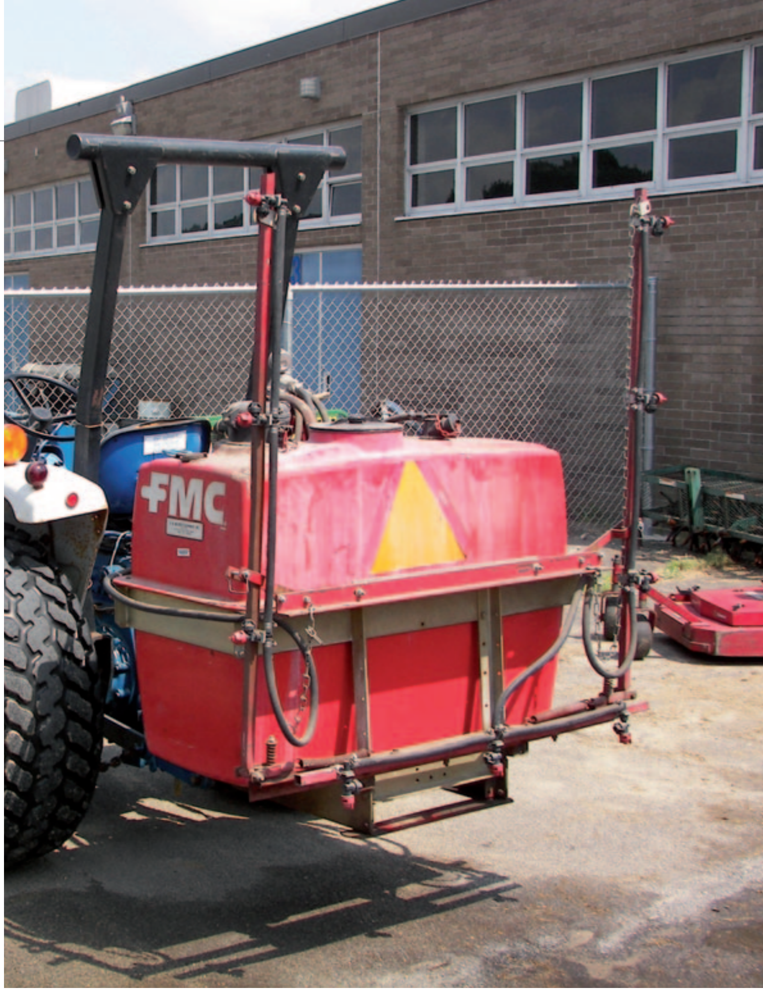
Sprayer calibration in a pinch



» THE GOAL was to calibrate an existing 30-year-old sprayer (with minimal equipment modification) to properly apply a systemic broadleaf herbicide.

SPORTS FIELD MANAGERS, particularly those working in a K-12 setting, do not always have access to state-of-the-art spray application equipment. In these settings, the application of liquid materials is frequently contracted out or the sports field manager must often work with available equipment.

The sports fields and grounds at Overbrook High School (Pine Hill Public Schools, Pine Hill, NJ) are overseen by Rich Watson, grounds supervisor and sports turf manager, and Bill Loftus, sports turf manager. The school owned a simple, functional, 30 year-old sprayer that could be used for the application of liquid materials. The sprayer consisted of a 100-gallon tank mounted on a tractor three-point hitch and a pump powered by the PTO. The boom was equipped with nine flat flan nozzles commonly used in turfgrass applications.

Rich Watson's goal was to properly calibrate this sprayer, with little or no modification to its existing set-up, to correctly apply a selective, systemic broadleaf weed herbicide.

What we knew about the sprayer and what we needed to determine. While there are various methods and techniques that can be used to calibrate a sprayer, we used the following formula to sort-out which variables we knew and which variable(s) needed to be determined to accurately deliver the broadleaf herbicide: GPM = [GPA x MPH x W] / 5940, where GPM = gallons per minute (per nozzle); GPA = gallons per acre (spray volume); MPH = miles per hour (tractor operating speed); and W = width (inches) between nozzles. The value of 5940 is a constant needed to convert units and is not derived in this article.

The sprayer was equipped with nine (9) XR TeeJet 8004VS nozzles positioned on 20-inch spacings across the boom. Per manufacturer specifications (TeeJet Technologies, Spraying Systems Co., Wheaton, IL), the nozzle output is designed to be 0.4 GPM and each nozzle will produce an 80-degree spray angle at an operating pressure of 40 pounds per square inch (psi).

Note that this calibration formula, nozzle nomenclature, and other technical information can be accessed at the TeeJet Technologies website (www.teejet.com).

The label of the broadleaf herbicide chosen for this application states that the product should be applied in 20 to 220 gallons of water per acre. While this is obviously a wide range, the product being used was a systemic broadleaf herbicide. The goal of applying a systemic herbicide is to simply deliver the product onto the leaf of the plant (as opposed to uniformly covering turfgrass leaves in the case of a contact pesticide). Thus, a target application rate of 40 GPA (approximately 1.0 gallon per 1000 sq ft) was appropriate for the systemic herbicide. Also, applying the product at this spray volume (as opposed to 80 GPA or greater) would require fewer tank refills to spray large acreages.

Figure 1. Using a calibration formula

The formula:

$$GPM = \frac{GPA \times MPH \times W}{5940}$$

GPM = gallons per minute (per nozzle)

GPA = gallons per acre (from label)

MPH = miles per hour

W = nozzle spacing (inches)

Variables:

GPM = 0.4
GPA = 40
W = 20
MPH = ?

Our calculations:

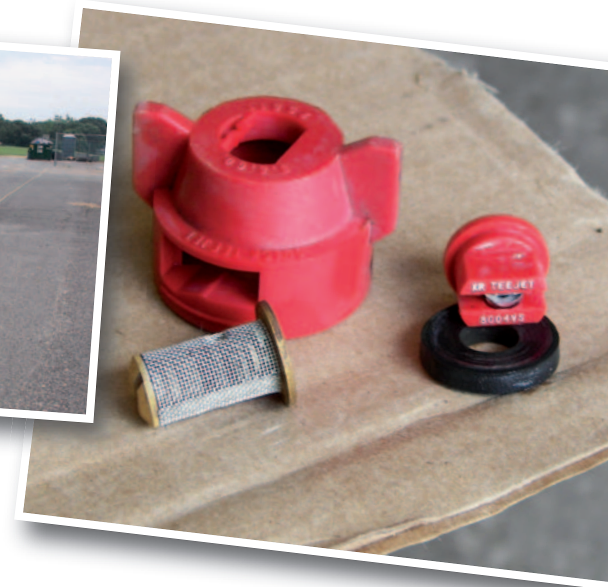
$$MPH = \frac{5940 \times GPM}{W \times GPA}$$

$$MPH = \frac{5940 \times 0.4}{20 \times 40}$$

MPH = 3.0

(All photos by Brad Park, Rutgers University).

Thus, with the existing sprayer components in mind (XR 8004 nozzles positioned on 20-inch spacings), it becomes clear upon examining the calibration formula that operating speed is the variable that needed to be determined to calibrate the sprayer to deliver 40 GPA of spray solution. Inputting our known variables into the equation, we determined that the sprayer required an operating speed of 3.0 mph (Figure 1).



CALIBRATING THE SPRAYER

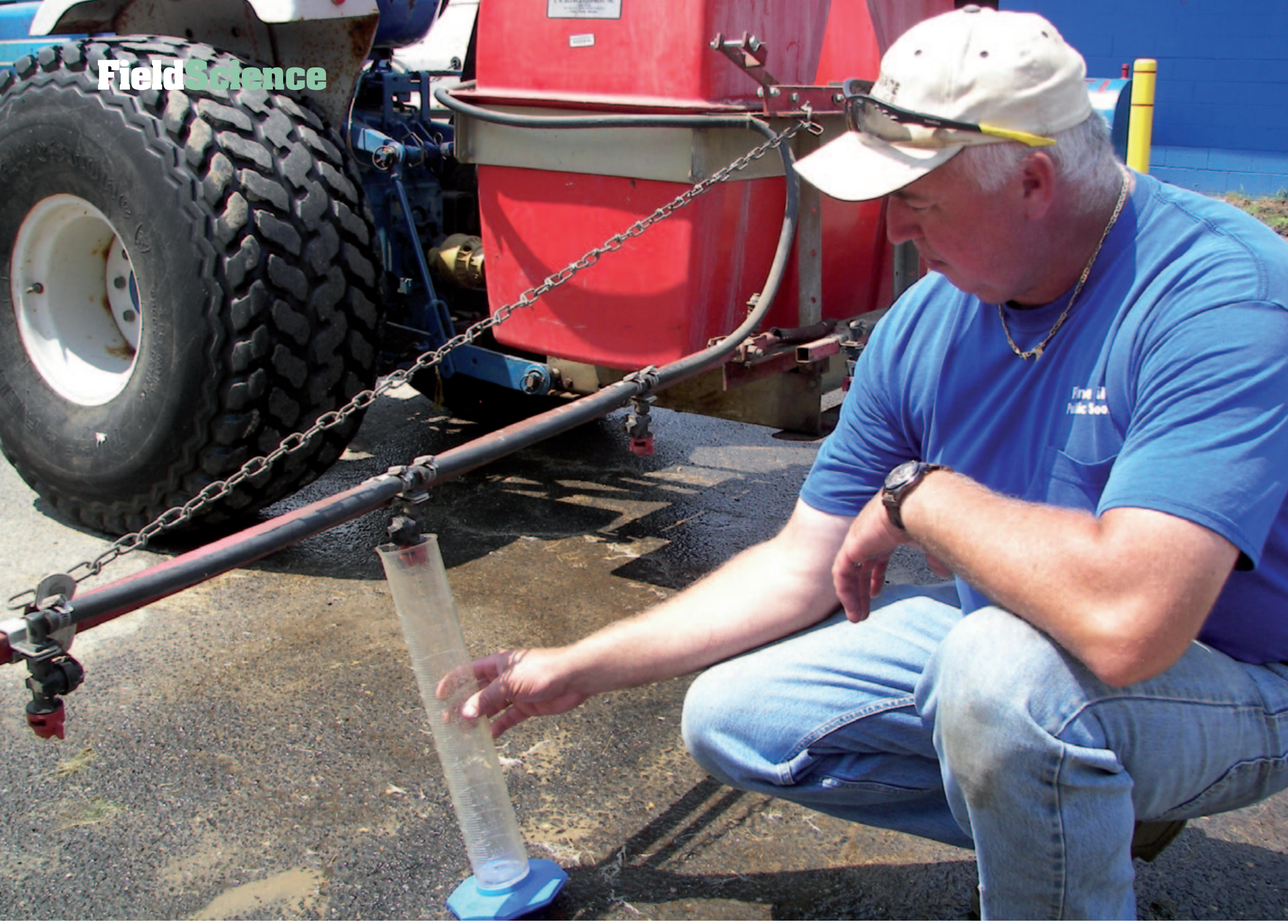
A 100-foot course was measured, the spray tank was filled halfway with clean water, and the tractor was operated numerous times over the course at varying ranges and forward gears at an engine rpm of 2100 (rpm necessary to maximize PTO performance) until the course was completed in 23 seconds. A speed chart was used to determine that 23 seconds were required to complete the 100-foot course at 3.0 mph; however, a calculation and unit conversions could have been performed to obtain the same information. Through trial and error, we determined that the tractor had to be operated in 3rd range and 2nd gear at 2100 rpm to complete the course in 23 seconds.

All nozzles, screens, and seat gaskets were removed from the boom the day before and soaked in an ammonia solution for 24 hours. Once cleaned, nozzle assembly components were then reassembled on the boom. This was an important step because clogged nozzles and screens will often produce an uneven appearance of the spray, which will affect spray volume and the uniformity of the application.

With the tractor engine rpm set to 2100 in an idle position and the PTO engaged, the sprayer was operated with clean water with the pressure regulator set to 40 psi. This allowed us to observe the operating appearance of the "fan" pattern produced by each nozzle, which we determined to be satisfactory.

Next, a graduated cylinder was used to confirm that each nozzle

» **Left:** A 100-FT COURSE was set-up to determine the tractor's range and forward gear necessary to achieve an operating speed of 3.0 mph.
» **Right:** EXISTING nozzles and components were allowed to soak in an ammonia solution for 24 hours before being reassembled on the sprayer boom.



» A graduated cylinder (ml) was used to check each nozzle for a calculated spray volume equivalent to 0.4 GPM (i.e. 380 ml in 15 seconds).

was delivering 0.4 GPM (Figure 2). At 0.4 GPM, each nozzle delivers 380 ml (~13 fluid oz) of water over 15 seconds. An acceptable margin of error is + 5%; hence, the acceptable amount of water to be collected ranged from 361 to 399 ml. Actual quantities collected ranged from 340 to 360 ml. The spray pressure was adjusted to 50 psi to increase spray output. An upward adjustment in pressure was not unexpected since the pressure gauge was mounted to the pressure regulator and the operating pressure at the nozzles was likely less due to friction associated with the spray solution moving though the hose lines. Spray output was increased to the acceptable range after the pressure adjustment.

Figure 2. Calculating how much water to collect per nozzle

Steps we took:

Our goal was to collect a quantity of clean water equal to 0.4 GPM per nozzle.
We had a graduated cylinder (ml).
We recognized that 15 sec is an appropriate amount of time to perform a spray volume check.

Calculations

$$\frac{0.4 \text{ gallons}}{1.0 \text{ minute}} \times \frac{3785 \text{ ml}}{1.0 \text{ gallon}} \times \frac{1.0 \text{ minute}}{60 \text{ seconds}} \times 15 \text{ seconds} = 380 \text{ ml } (\sim 13.0 \text{ oz})$$

2) We needed to collect 380 ml (±5%) per nozzle in a 15 second period.
3) The pressure regulator was set to 40 psi (per manufacturer specifications).
4) Our collected volume ranged between 340 and 360 ml (outside 5%).
5) We increased the pressure regulator to 50 psi to reach desired input.

FINAL STEPS

Per manufacturer specifications, the XR TeeJet 8004VS nozzles positioned on 20-inch spacings should be set at 17 to 19 inches above the intended target. Thus, the boom height was adjusted to set the nozzles at 20 inches above the paved surface; this height is approximately 18 inches above the 2-inch high turfgrass canopy (the intended target).

We then operated the sprayer (filled with clean water) across a dry, paved surface at the calibrated speed and pump pressure to

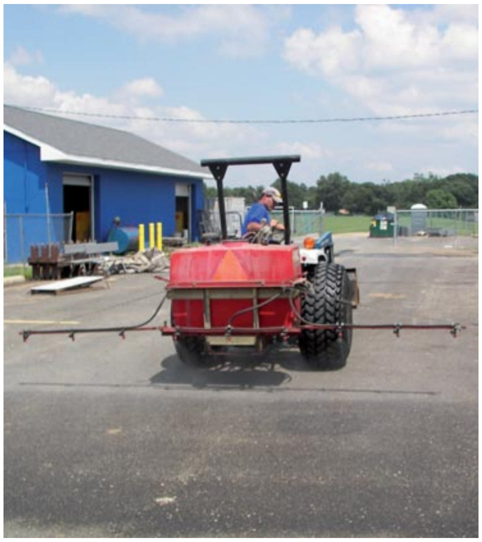
Within 2 weeks, white clover control was judged to be "excellent."

observe the drying pattern of the spray solution. The spray dried in a uniform pattern (i.e. there were no visible streaks resulting from improper overlap); hence, the nozzle spacing and height were set properly.

The following day, the broadleaf herbicide was applied using the sprayer set to the calibrated speed and pressure. A minimal amount of spray solution remained in the tank after the application was made—an indication that our calibration efforts were successful. The remaining solution was diluted and "sprayed-out" multiple times in out-of-play border areas at the far-end of the facility. Within 2 weeks, white clover control was judged to be "excellent."

Laws pertaining to fertilizer and pesticide applications are becoming increasingly restrictive, particularly on school properties. Heighted parent and environmental interest-group awareness of chemical tools used on public grounds drives much of this regulatory policy. It is important that chemical applications are made thoughtfully and in accordance with their product labels. A thorough understanding of the sprayer calibration process allowed the application of a broadleaf herbicide at Overbrook High School to be successful. ■

Brad Park is Sports Turf Education and Research Coordinator, Rutgers University and member of the Board of Directors, Sports Field Managers Association of New Jersey (SFMANJ).



» Water was sprayed on a paved surface using the calibrated sprayer to observe the drying pattern. A uniform drying patter, absent of skips and streaking, indicates proper nozzle performance and positioning.