$$GPAPN = \frac{5940 \times .067}{4 \times 20}$$

How to Calibrate Turf Sprayers

$$\frac{Y \times MPH}{325} = APH$$

$$\frac{GPAPN \times MPH \times W}{5940}$$

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NOTEWORTHY PROGRESS in studies of turf problems by experts at state universities and experiment stations has made good maintenance somewhat easier. Likewise modern chemical technology has developed new chemical sprays which assure good control of both animal and plant pests. Higher costs of modern day chemicals, and critical rates at which they must be applied for best results, make close attention to sprayer calibration important.

Current information, formulas and procedures can help the somewhat perplexing and complicated-appearing task of calibrating sprayers. Correct sprayer and boom calibration are important to the success of a control program.

Consider Four Factors

There are four major factors to consider in the calibration of a turf sprayer:

(1) Nozzle spacing on the boom and boom width;

(2) Ground speed of the sprayer in miles per hour, MPH;

(3) Recommended application rate; in gallons per acre, GPA;

(4) Discharge rate per nozzle in gallons per minute, GPM.

Discharge rate of the nozzle depends on the size of the nozzle orifice and the operating pressure of the pump. Consider all of these factors and how you may utilize them to arrive at the recommended rate of application.

Nozzle Spacing

Nozzle spacing is a known factor, as is the width of the boom. To determine the spray swath, or effective width of your boom, simply measure the distance between nozzles and multiply by the number of nozzles on the boom.

For example, assume you have a boom with 13 nozzles, spaced 20 inches apart. Thus, 13 × 20 = 260 inches, divided by 12" = 21 ft. 9 in., the effective width of the boom.

Determine Ground Speed

Consider the ground speed of the sprayer and select the speed best suited to the type of terrain. Determination of this speed is made with the tractor and sprayer in motion. When the desired speed is found, drop a marker, a stick or a wrench. Exactly one minute later, drop another marker. Measure the distance between markers to find the number of feet traveled in one minute (60 seconds). With this information, compute the speed of travel, in MPH, with this formula:

$$\frac{\text{Distance in feet}}{\text{Time in seconds} \times 1.47} = \text{MPH}$$

Example: If 360 feet is the distance traveled in one minute, or 60 seconds, the speed of travel is 4 MPH.

$$\frac{360}{60 \times 1.47} = 4 \text{ MPH}$$

In this example, 360 represents the

distance traveled and, according to our formula, is divided by 60, representing the time, in seconds, during which the distance was traveled. This is multiplied by the constant 1.47. Thus; $60 \times 1.47 = 88.2$ which now becomes our divisor:

$$\frac{360}{88.2} = 4 \text{ MPH}$$

Determination of the speed of travel is the *most important step* in the calibration of a turf sprayer. The method described above is easy to follow. If your vehicle has a speedometer, this step, of course, can be eliminated.

Know Proper Rate

The third factor to decide on is the recommended application rate. This is almost always a known factor and should be the gallons-per-acre (GPA) rate recommended by your turf advisor or experiment station. Such turf specialists should be consulted for recommended application rates for various types of spray materials and control programs. They are best qualified to advise you on these subjects.

Figure Nozzle Output

A fourth factor to consider is the rate of discharge per nozzle in GPM, or the nozzle output. This can be obtained from sprayer manufacturers, manufacturers of nozzle tips, or from spec sheets that accompanied the equipment when it was purchased.

If such data are not available, or you suspect the nozzle orifices (holes) are worn enough to lose their original output rate, you can determine their actual output yourself.

The following formula is used to determine the GPM per nozzle for a blanket type spray, such as is used in overall fairway spraying operations, when the rate of travel in MPH, the *desired* application rate in gallons per acre (GPA), and the nozzle spacing, are known:

$$\frac{\text{GPAPN} \times \text{MPH} \times \text{W}}{5940} = \text{GPM per nozzle}$$

First then, the GPA per nozzle (GPAPN) must be determined. Assume for example, that we are using a boom with 13 nozzles, spaced 14 inches apart (W). From previous calculations, we know ground speed is 4 MPH. In this instance, your turf advisor has recommended 65 gallons per acre (GPA) as the dosage. The recommended 65 gallons per acre is divided by the number of nozzles on the boom (13) giving 5 GPA per nozzle (GPAPN). Next, multiply GPAPN (5) by MPH (4) and then by the nozzle spacing (W) in inches (14). Divide by the constant 5940 and the answer is .047 GPM per nozzle. Here are the calculations:

$$\text{GPM per nozzle} = \frac{\text{GPAPN} \times \text{MPH} \times \text{W}}{5940}$$

$$= \frac{5 \times 4 \times 14}{5940}$$

$$= \frac{280}{5940}$$

$$\text{GPM per nozzle} = .047$$

To apply 65 GPA, using a boom with 13 nozzles spaced 14 inches apart when the ground speed is 4 MPH, each nozzle must discharge .047 GPM.

If the nozzle spacing is 20 inches, which is standard spacing on most booms sold today, use 20 as the value of W.

To determine if your nozzles discharge the correct amount,

With nozzles set to spray at 65 degrees, this boom spray system delivers even coverage with little drifting caused by wind. Boom is 22 inches from the ground.

Eighty degree spray patterns assure adequate overlap by this boom sprayer system. Conical discharge patterns of the spray marks this boom as well maintained.

check the discharge of one nozzle in a calibrated container for one minute, while the sprayer is operating at 40 p.s.i. If the output from the nozzle is supposed to be .067 gallons per minute, 8.5 fluid ounces should have been collected during the one-minute discharge time.

To convert ounces to gallons, use the following formula (128 oz. = 1 gal):

$$\frac{128 \text{ oz.}}{1 \text{ gal.}} = \frac{8.5 \text{ oz.}}{Z}$$

$$128 \times Z = 1 \times 8.5$$

$$Z = .067 \text{ GPMPN}$$

If, for example, more than 8.5 oz. are collected in one minute, substitute the number of ounces you collect for the 8.5 in the above formula to get the nozzle output.

These calculations may not appear to be important, but remember that 3/100ths of a gallon excess output per nozzle, multiplied by the number of nozzles on your boom and the number of minutes of use in the field, will total many gallons of wasted chemical.

Determine GPA from Worn Nozzle

If the nozzle being calibrated turns out to be the proper size, things are fine. However, in case the calibration does not come out as required, don't throw away the nozzles. Here is another formula which reveals what gallons per acre application they *will* give.

$$\text{GPAPN} = \frac{5940 \times \text{GPMPN}}{\text{MPH} \times \text{W}}$$

For example, multiply the constant 5940 by the actual GPM measured from each nozzle during one minute at 40 p.s.i. This product is divided by MPH × W, and the answer will give you the gallons per acre per nozzle (GPAPN).

Let us say that nozzle discharge was measured to be .067 gal. (8.5 oz.) per minute, that MPH is 4, and the nozzles are spaced 20 inches apart. Putting these values into the formula, we have:

$$\text{GPAPN} = \frac{5940 \times .067}{4 \times 20}$$

$$= \frac{397.98}{80}$$

= 4.9 gallons per acre your nozzle will discharge.

Total GPA is thus found by multiplying the number of nozzles (13) by GPAPN (4.9). The answer is 65 gallons per acre which, in this case, was the recommended rate.

Suppose that the nozzles are worn, the orifice sizes are enlarged, and the discharge rate is greater but to an unknown degree. This same formula will tell you their exact capacity, as well as the gallons per acre they will apply.

Suppose your one-minute measurement revealed a discharge rate of 12.5 fluid ounces. Convert this to gallons (12.5 fl. oz. ÷ 128 fl. oz. = .097) and you will come up with a figure very close to 0.10 gal. per minute per nozzle. Use this known result in the above formula to obtain the exact gallons per acre you can expect to obtain from worn nozzles. In this example, the calculations look like this:

$$\frac{5940 \times .10}{4 \times 20} = \text{7.4 gallons per acre per nozzle}$$

Multiplying this result by your 13 nozzles, 13 × 7.4 = 96.2 GPA, the output these 13 nozzles produce. This higher rate per acre results directly from the worn orifices in the old nozzles. If the rate per acre is satisfactory for your program there is no reason why they cannot still be used. But, if the rate is too high, discard the nozzle tips, and buy new ones of correct size. Depending on the abrasives in your water supply, nozzle wear is not uncommon, even within a short time.

It is possible to reduce the GPA rate even with worn nozzles by increasing the ground speed. However, for most courses a speed much more than 4 MPH is not too practical.

Abbreviations Used in This Article

GPA =	Total gallons per acre
GPAPN =	Gallons per acre per nozzle
GPM =	Gallons per minute
GPMPN =	Gallons per minute per nozzle
MPH =	Miles per hour
W =	Nozzle spacing in inches
APH =	Acres per hour
Y =	Boom width in feet
8.25 =	Constant for APH
5940 =	Constant for GPMPN

What Nozzle Numbers Mean

When you see a nozzle tip which reads 650067 or 65015 or 73039 or 800067 or 8002, have you ever wondered just what these numbers mean to you? Actually nozzle numbering systems are easy to understand once they have been explained.

First thing to remember is that the first two numbers *always* indicate the angle of spray discharge. Thus any nozzle beginning with 65, such as 650067, has a 65 degree spray angle; any nozzle beginning with 80, such as 8002, has an 80 degree spray pattern. The reason for these different angles is to provide a 25% overlap in spray pattern for even coverage when the nozzles are used at various heights from the ground.

For example, when spraying height is 17 to 19 inches from the ground, the wider angle, 80 degree nozzles are recommended. When spraying heights are 19 to 21 inches, an intermediate nozzle, 73 degree series, is recommended. When spraying heights are from 21 to 23 inches, the 65 degree series is recommended. This last series is most widely used today.

Risk of drift is greater at wider angles. Narrower, 65 degree nozzles, provide a coarser droplet size and reduce the risk of drift.

What do the rest of the numbers mean? They indicate the GPM of that particular nozzle at 40 PSI (which is the standard from which all other calculations are made).

Take, as an example, nozzle tip No. 650067, which happens to be the same nozzle used in our previous examples. To know the GPM of this nozzle at 40 PSI, simply count three decimal points from the left and place a decimal point. We find we have the decimal .067, which is the GPM of this nozzle at 40 PSI.

If you had a nozzle numbered 65015, you would count over three places from the left and place the decimal point between the zero and the 1. You would then have the decimal .15, which represents the GPM at 40 PSI of this nozzle. If you had a nozzle carrying the number 73039, you'd place the decimal point three places from the left between zero and three; the nozzle would have an output of .39 GPM at 40 PSI. Now let us say you have some nozzles marked 800067. Counting three places from the left, you'd place the decimal point between zero and zero. The remaining decimal is .067 GPM at 40 PSI; the same as nozzle No. 650067 used in an earlier example, but in the 80 degree series. Thus the GPM capacities of various spray angles, can be duplicated.

Set Pump Pressure

Up to this point we have not discussed pump pressures. To maintain the gallonage requirements per nozzle, pounds of pressure per square inch must be known. When a nozzle chart is not available, this can pose a problem because it is necessary to maintain exacting pressures in order to obtain an accurate rate of discharge from a nozzle.

The formula to obtain the GPA per nozzle has been shown. From our example, we determined that .067 GPM per nozzle was required. To determine the proper pressure setting at the relief valve, or regulator, the following steps should be taken:

(1) Install all nozzles in the boom.

(2) Start the sprayer and run at factory-governed speed if engine driven; if power-take-off (PTO) operated, set tractor throttle at predetermined position for the proper ground speed we have selected and the proper PTO speed. This should be the equivalent of 560 RPM on the PTO shaft.

(3) Set the sprayer relief valve or regulator at an approximate setting of from 40 PSI to 60 PSI.

(4) Start spraying, open the boom valves to full capacity. Catch the discharge from two or more nozzles in separate containers for exactly one minute.

(5) Measure the material discharged and compare it with the quantity needed. As we have previously determined, this quantity should be .067 gal., or 8.5 fluid ounces per nozzle. If the quantity discharged is too little, increase the pump pressure slightly and recheck; if the quantity is too great, lower the pressure slightly and recheck.

Several settings may be required the first time this pressure calibration is made, but with a little experience, much less time may be required for later calibrations if they become necessary.

Formula for Acres per Hour

Still another formula we have not discussed is quite useful to determine manpower distribution for spraying programs. This formula calculates the number of acres sprayed in one hour. The formula to determine this factor is as follows:

$$\frac{Y \times MPH}{8.25\ (\text{constant})} = APH$$

With the symbol Y, representing the boom width in feet, we multiply the ground speed (MPH), divided by the constant 8.25. The product is the APH, or acres sprayed in one hour.

As an example, let us say you are using a Model 308 John Bean Duo-Flex Boom which has 13 nozzles spaced at 20 inches and provides a spray swath of 21 ft. 8 inches or 21.67 ft. You have decided on a spray program which requires a ground speed of 4 MPH. This would be your calculations:

$$APH = \frac{21.67 \times 4}{8.25}$$

$$= \frac{86.68}{8.25}$$

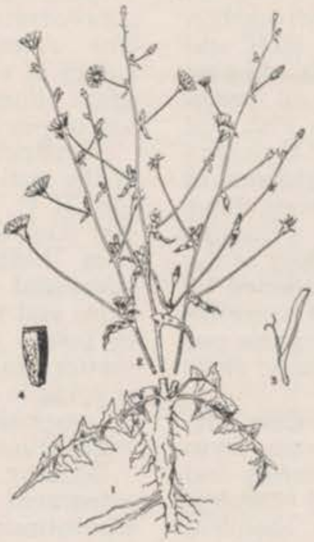
$$= 10.5 \text{ acres per hour}$$

Calibrating sprayer equipment is important in your overall operation. Experiment stations

(Continued on page 28)

CHICORY

(Cichorium intybus)



Chicory is a perennial which reproduces by seed; it is also known locally as wild succory and blue daisy. This native of Europe is common across the United States with the exception of the Deep South. It may be found along roadsides, in pastures and meadows, on vacant city lots, and other waste places.

Initial plant growth is a rosette which resembles dandelion, having deeply scalloped leaves. Sometimes these leaves are cultivated and harvested for salads or greens, since chicory is a close relative of endive. Later the rosette sends up an erect stem which may reach to 7 feet high. The stem (2) is smooth and much-branched in the upper portions. The hollow stem center is filled with a bitter-tasting milky sap.

Leaves on the lower portion of chicory retain the dandelion shape, but upper leaves are small, tonguelike and sit directly on the stem.

Flower heads are borne on stalks which grow from the axils of leaves. Each flower head is made up of many tiny disc flowers (3), each with its single yellow petal. The conspicuous blue petals are called ray flowers; they are sterile and produce no seeds. The ray flowers open in morning and evening, and close over the disc flowers during the day.

Seeds are dark brown and wedge shaped; they are ⅛ inch long and have a row of bristlelike scales along the top (4).

The root is a white fleshy taproot (1) which grows deeply. It is sometimes cultivated, harvested, dried and used as an addition to or substitute for coffee.

One or two sprayings of 2,4-D will selectively kill this weed. Three or four mowings per year likewise will kill it. It should not be permitted to drop seed.

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How to Calibrate Turf Sprayers

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and turf advisors should be consulted for their recommendations before a spraying program is started. If their recommendations are followed faithfully, your spraying program will be successful. If not, the best sprayer made cannot do the job for which it was intended.

Another important point to consider is the choice of spraying equipment. Be sure the sprayer has sufficient capacity to carry out your full program. Make sure it has a tank and piping system which are protected against the ravages of modern day chemicals. Be certain it has a good filter or ample capacity; plugged nozzles will upset your rate of application. Be doubly sure it has a pump that can withstand abrasive and corrosive chemicals you will be using. It should have an accurate and reliable pressure gauge and pressure regulator or relief valve. Make sure also that the boom is protected inside against rust and corrosion.

Buy your sprayer from a reliable source, preferably your turf equipment supplier. He has access to factory warranty and service programs which can be very helpful. Take good care of your spraying equipment; keep it in good condition. Periodically check nozzle capacities. Follow closely the recommendations of your turf advisors, and your spraying program will be successful.

Elm Beetles Scavenge Kansas

Elm leaf beetles reportedly defoliated Chinese and hybrid elm trees throughout Kansas this summer. Dr. Hugh E. Thompson of the Kansas State University Extension Service said leaves chewed by the beetles dropped to the ground. "Fully grown elm beetles are crawling down the trunks of trees and going into tree crevices or into grass and other hiding places," he noted.

Thompson added that the insect has three or four generations in Kansas. The second generation is working at present and