SPRAYER CALIBRATION

Objective: Determine the volume or weight that application equipment will apply to a known area under a given set of conditions.

VOLUME OF PESTICIDE SOLUTION APPLIED DEPENDS UPON:
NOZZLES, PRESSURE ,SPEED, Spacing of Nozzles, Viscosity of liquid

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NOZZLE TIP DESIGNATIONS
SPRAYING SYSTEMS CO.

HSS8002E
HSS 80 02 E
HSS = hardened stainless steel
80 = 80 degree spray angle
02 = 0.2 gallon per minute at 40 psi
E = even flat fan pattern for band application

HOW TO CHOOSE THE RIGHT NOZZLE SIZE

$$GPM = \frac{GPA \times MPH \times \text{Nozzle spacing in inches}}{5940}$$

GPM = Gallons per minute per nozzle
GPA = Gallons per acre
MPH = Miles per hour

EXAMPLE
GPA = 30
MPH = 4
Nozzle spacing = 20 inches

$$GPM = \frac{30\ GPA \times 4\ MPH \times 20\ Inches}{5940}$$

GPM = 0.40

Find nozzle capacity in GPM in manufacture's catalog.
Desired spraying pressure = 40 psi
Using Spraying Systems catalog an 8004 nozzle would work the best.

HOW TO CHANGE SPRAYER OUTPUT

1. **NOZZLES:** Best for large changes in output
2. **PRESSURE:** Only feasible within a limited pressure range. Pressure must be increased by a factor of 4 in order to double the flow.
   10 GPA at 20 PSI
   20 GPA at 80 PSI
3. **SPEED:** Only feasible within a limited range of speeds. Double ground speed will decrease output by 50%.

MAXIMIZING SPRAYER PERFORMANCE

BOOM HEIGHT

Rule-of-Thumb when using 80 degree tips. Set the boom above the target whatever the distance is between nozzles. If nozzle spacing is 20" then set the boom 20" above the target. For other nozzle types see the manufacture's literature.

NOZZLES

Nozzle types: Flat fan is the best for broadcast application of herbicides.

Nozzle placement

Need to be placed so that there is proper overlap. Flat fan nozzles should overlap 30%.

Nozzle uniformity

Nozzle types and orifice sizes must be the same across the boom.

Nozzle orientation

Directed straight down toward the ground and angled 5 to 10 degrees from parallel to the boom to prevent collision of spray droplets from adjacent patterns.

Nozzle materials

Stainless steel, brass, and plastic are the most common. Stainless steel is probably the best choice.

Screens and filters

Use appropriate screens and filters. 0.2 GPM or more use 50 mesh, less than 0.2 GPM use 100 mesh.

CALIBRATION OF SPRAYERS

Sprayer calibration consists of three major steps:

1) **Ensure a uniform discharge from each nozzle tip**
2) **Document the sprayer output in gallons per acre**
3) **Determine the amount of pesticide to add to the tank.**

Items needed for calibration.

1) **Measuring tape 2) Stop watch 3) Collection tube 4) Flags or markers**

Measure nozzle output under field conditions.

STEP 1. ENSURING UNIFORM FLOW FROM ALL NOZZLES

1. **Determine the best operating speed to suit field conditions.**
2. **Select proper nozzle.**
3. **Be sure selected tips deliver in the desired rate range.**
4. **Remove and clean all nozzle tips and screens.**

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5. **Use clean water and flush sprayer system.**
6. **Replace all screens and tips. Make sure all nozzles are the same.**
7. **Check flow from each nozzle. Do this daily.**
8. **Adjust pressure.**

STEP 2. DETERMINE SPRAYER OUTPUT IN GALLONS PER ACRE

1. **Field acres vs. treated acres (band)**
   a) **Field acres = Crop acres**
   b) **Treated acres = amount of land sprayed**

When banding only a portion of the total crop receives the spray. Calibration is based on the actual treated acres.

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2. **Gallons per acre applied depends on:**
   1) **orifice size of nozzle tip 2) pressure of liquid at the tip 3) speed nozzle tip is moved across the field**
   4) **the viscosity of the liquid being sprayed**

THE REFILL METHOD OF CALIBRATION

Broadcast Application

1. **Fill spray tank with water**
2. **Adjust pressure within recommended range for nozzles used.**
3. **Select easily maintained speed that fits field conditions.**
4. **Spray a measured area. Need to know sprayed swath width (ssw) not boom length.**
   ssw = noz spacing (ft) x # of noz
   Example: A boom has 18 nozzles spaced 20 in. apart.
   ssw = (20in / 12in per foot) x 18 nozzles = 30 ft
   Measure off an area to equal 1/10 of an acre.
   30 ft $\times$ X ft = 43,560 ft/a / 10
   X = 4356ft^2 / 30ft = 145.2 ft
   Therefore, measure off an area 30 ft by 145.2 ft and this will = 1/10 acre.

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5. **Return to filling point.**
6. **Measure amount of water to refill tank.**
7. **Calculate spray rate. With this formula:**

$$\text{gpa} = \frac{\text{gallons sprayed x 43,560}}{\text{swath width x swath length (ft)}}$$

Example: A field sprayer with a 30 ft spray swath is sprayed for a distance of 145.2 ft. 4 gallons of water are needed to refill the tank. What is the spray rate?

gpa = 4gal x 43,560ft^2 / 30ft x 145.2ft = 40 gpa

Band Application

1. **Fill spray tank with water**
2. **Adjust pressure**
3. **Select speed**
4. **Measure band width (ft) and multiply by number of bands treated at one time**
5. **Spray a measured distance in field**
6. **Return to filling point**
7. **Measure amount of water to refill tank**
8. **Calculate spray rate on the band with this formula:**

$$\text{gpa} = \frac{\text{gallons used x 43,560}}{\text{treated width x distance (ft)}}$$

Example: A 6-row planter sprays a 12 inch band centered over 36 inch rows. It is sprayed for 300 ft and uses 0.75 gallon of water. What is the spray rate?

treated width = (12in x 6rows) / 12in per foot = 6 ft

gpa = 0.75 x 43,560 / 6 x 300 = 18.2 gpa

A 100 gallon tank can treat 100gal / 18.2gpa = 5.5 acres of bands.

However, actual field coverage is equal to:

FAT = (TAT x ROW) / BAND

FAT = Field acres/tank

FAT = Treated acres/tank

ROW = Row spacing (in)

BAND= Band width (in)

FAT = (5.5TAT x 36" ROW) / 12" Band = 16.5 FAT

STEP 3. ADDING PROPER AMOUNT OF PESTICIDE TO THE TANK

1. **Divide the capacity of the tank by the gallons applied per treated acre to find the treated acres per tank of spray.**
2. **To determine how much chemical to add to the tank, multiply the recommended formulated rate per acre by the number of treated acres the tank will cover.**

3. **Field acres represent the normal reference to field size. In broadcast spraying field acres/tank and treated acres/tank are the same. When banding, treated acres/tank will always be less than field acres per tank.**

BROADCAST: FAT = TAT

BAND: FAT = $\frac{\text{TAT x ROW}}{\text{BAND}}$

Where: FAT = Field acres/tank
TAT = Treated acres/tank
ROW = Row spacing, inches
BAND= Band width, inches

EXAMPLE: 200 gallon tank, 10 gallon/acre, 36 inch rows, 12 inch band, 2.5 lbs/acre of AAtrex 80W.
Step 1. 200 gal / 10 gpa = 20 TAT
Step 2. 2.5 lb/a x 20 TAT = 50 lb/T
Step 3. FAT =(20TAT x 36" ROW) / 12" BAND = 60 FAT

EXAMPLE: 300 gallon tank, 40 gallon/acre, 0.5 qt/acre of Banvel.
Step 1. 300 gal / 40 gpa = 7.5 TAT
Step 2. 0.5 qt/a x 7.5 TAT = 3.75 qt/T

WHAT IF YOU ONLY WANT TO TREAT 5.2 ACRES?
5.2 a x 40 gpa = 208 gallons
5.2 a x 0.5 qt/a = 2.6 qt

WHAT IF YOU HAVE 35 GALLONS LEFT IN THE SPRAY TANK AND YOU WANT TO TREAT 4 ACRES?
35 gal / 40 gpa = 0.875 acres
4 a - 0.875 a = 3.125 acres
3.125 a x 40 gpa = 125 gallons
3.125 a x 0.5 qt = 1.56 qt or 50 oz

WHAT IF PESTICIDE RATES ARE LISTED IN TERMS OF POUNDS OF ACTIVE INGREDIENT PER ACRE?
Example: You are told to apply 2 lb ai/a of 2,4-D. 2,4-D has 4 lb ai/gal. How many quarts of 2,4-D will you need to apply per acre?
chem needed = rate (lb ai/a) / chem conc.
2lb ai/a divided by 4lb ai/gal = 0.5 gal/a or 0.5gal/a x 4qt/gal = 2 qt/a

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Example: You need to apply 0.5 lb ai/a of an 80% WP. How many pounds of product will you need to apply per acre?
0.5lb ai/a divided by 0.80 ai = 0.625 lb/a

1/128 METHOD OF CALIBRATION (see handouts: (1) calibrating hand sprayers and high pressure hand guns) and (2) multiple nozzle boom-type sprayers

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CALIBRATING GRANULAR APPLICATORS
1. **Adjust orifice and fill hopper.**
2. **Operate the unit in the field to be treated and collect the granules as the unit is operating.**
3. **Weigh the amount of chemical delivered.**

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4. **Calculate the area treated.**
   band width x number of rows x length; or row spacing x number of rows x length; or swath width x length
5. **lb of granules/a = $\frac{43{,}560\ ft^2/a \times \text{lbs of granules collected}}{\text{area of measured course in } ft^2}$**

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6. **The above steps may have to be repeated until the desired amount is delivered.**

Example: A granular applicator treats a swath width of 20 ft and is driven over a distance of 217.8 ft. The unit delivers 0.7 lb. What amount of granules are being applied per acre?
43,560 ft^2 /a x 0.7lb / 4,356ft^2(area of measure course) = 7 lb/a

You want the unit to deliver 100 lbs of product per acre. What needs to be done?

Unit should deliver:
$\frac{100\ lbs/a \times 4356\ ft^2}{43{,}560\ ft^2/a}$ = 10 lbs
in the measured course.
Adjust the orifice until 10 lbs are collected per 4356 ft^2.

FACTORS AFFECTING GRANULAR APPLICATORS
1. **Exposed area of the metering orifice**
2. **Speed of the agitator**
3. **Ground speed of the applicator**
4. **Nature and size of the granules**
5. **Roughness of the field**
6. **Humidity and temperature**

When any of the above factors change the applicator should be re-calibrated.

SOLUTIONS AS PERCENT OR PPM

Percent concentration by weight:

lbs to use = $\frac{\%\text{ by wt x gal final mix x 8.34 lb/gal}}{\%\text{ strength of chem to be used}}$

Example: How much WP containing 40% ai should be added to a 250 gallon tank if the recommended treatment is 0.25% by weight?

$\frac{0.0025 \times 250\text{gal} \times 8.34\text{ lb/g}}{0.40}$ = 13 lbs

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Percent concentration by volume:

gal to use = % by vol x gal final mix

Example: When using Ally it is suggested you add a surfactant at 0.25% by volume. How much surfactant should be added to a 300 gallon spray solution?

0.0025 x 300 = 0.75 gallons or 3 quarts

Parts per million (ppm): Wettable Powder

lbs to use = $\frac{\text{ppm desired x gal final mix x 8.34 lbs/gal}}{1\text{ million x \% strength of chem used}}$

Example: How much WP containing 40% ai should be added to a 100 gallon tank if the recommended treatment is 1200 ppm?

$\frac{1200\text{ppm} \times 100\text{gal} \times 8.34\text{ lb/gal}}{1\text{ mil} \times 0.40}$ = 2.5 lbs

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Parts per million: Liquid

gal to use = $\frac{\text{ppm desired x gal final mix x 8.34 lb/gal}}{1\text{ million x lbs ai/gal}}$

Example: How much liquid EC containing 0.625 lbs ai/gal should be added to a 100 gallon tank if the recommended treatment calls for 300 ppm ai of a liquid chemical?

$\frac{300\text{ppm ai} \times 100\text{gal} \times 8.34\text{ lb/gal}}{1\text{ mil} \times 0.625\text{ lb ai/gal}}$ = 0.4 gallons

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SUMMARY

Find a calibration method you understand and use it every time.

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