Calibration of herbicide sprayers

Guy Kyser, Plant Sciences Department, UC Davis

- Broadcast applications
- Directed treatments
Why calibrate?

• Underapplication
• Overapplication
The Weed Research and Information Center is an interdisciplinary collaboration that fosters research in weed management and facilitates distribution of associated knowledge for the benefit of agriculture and for the preservation of natural resources.

WHAT'S NEW

- WANTED: Cooperative Extension Weed Science Specialist
- Weeds featured in IPM News
- Annual Bluegrass Pest Notes **REVISED PUBLICATION**
- UC graduate student Morcetti named University Medalist at Fresno State
- UC Davis weed science graduate student Kleist awarded CCST Fellowship

CALENDAR

- 2013, Jan. 23-25: California Weed Science Society Annual Conference
- 2012, Feb. 4-7: Weed Science Society of America Annual Meeting
- 2013, Mar. 11-14: Western Society of Weed Science Annual Meeting
Learn Weed Control from the Expert
Weed Research and Information Center

Herbicides in Natural Areas

Control Techniques
Principles of Weed Control
Calibration in Natural Areas
Weed Identification

Recent Posts
- Applying Herbicide Selectively and Application Safety
- Find the Right Concentration of Herbicide
- Biological and Herbicide Control of Weeds
Broadcast application

- Usually uses selective herbicide
- Small amount of herbicide in water
- Requires careful calibration, application
Pressure
  • nozzles
  • boom height
Output
  • flow rate
  • overall spray volume
Speed
  • spray width
  • acre length
  • pacing yourself
Pressure
  • nozzles
  • boom height

Output
  • flow rate
  • overall spray volume

Speed
  • spray width
  • acre length
  • pacing yourself
Pressure
Pressure ~ 30 psi
Pressure ~ 30 psi
Pressure
~ 10 psi
Boom height
80° nozzles, 20-inch spacing
TeeJet XR ("Extended Range") nozzles
TeeJet XR8002

80° fan, “02” means 0.2 gpm / 40 psi
- Works at a range of pressures
- Good for 10 to 25 gallons per acre at a walking pace, 30 psi
TeeJet XR8002

“Air Induction Extended Range”

TeeJet AIXR11002
TeeJet XR8002

“Air Induction Extended Range”

- Bigger droplets
- Less drift
- 110° fan

TeeJet AIXR11002
80° nozzles

30"
110° nozzles

20”
Pressure
  • nozzles
  • boom height

Output
  • flow rate
  • overall spray volume

Speed
  • spray width
  • acre length
  • pacing yourself
Flow rate
- How many gallons in one minute?
Output, each nozzle, 135 to 140 ml (~ 4 ⅔ oz)

• 3-nozzle total = 14 oz
• 15-sec spray time x 4 → 56 oz/minute
• 56 oz/128 oz (1 gal) = 0.44 gal per minute
14 oz/15 sec in gallons/minute

(14 oz) / (15 sec) = 0.4375 US gallons / minute
14 oz/15 sec in gallons/minute

415 ml/15 sec in gallons/minute

(415 ml) / (15 sec) = 0.438525607 US gallons / minute
Pressure
• nozzles
• boom height

Output
• flow rate
• overall spray volume

Speed
• spray width
• acre length
• pacing yourself
Spray volume
Total gallons of diluted herbicide solution applied per acre (g.p.a.)

• Usually ounces or pints of herbicide in gallons of water

• Spray volume and speed are connected!

• For walking applications with 02 size nozzles, 10 to 25 g.p.a. is good
Spray volume

- Spray volume / flow rate = number of minutes to treat one acre

- In our example,
  20 g.p.a. / 0.44 gal per min = 45.5 minutes to put out 20 gallons
(15 sec) / (415 ml) = 45.6073709 minutes / (20 US gallons)
Application speed
Pressure
• nozzles
• boom height

Output
• flow rate
• overall spray volume

Speed
• spray width
• acre length
• pacing yourself
3 nozzles
x 20 inch spacing
3 nozzles
x 20 inch spacing
Spray width

3 nozzles
x 20 inch spacing
= 60 inches (5 ft)
Spray width

12 nozzles x 20-inch spacing
= 240 inches (20 ft)
Spray width
Spray width
1 acre
(43560 ft²)
1 acre
(43560 ft\(^2\))
"Acre length"

43560 ft$^2$ / 5 ft (spray width) = 8712 ft
Application speed:
how fast you have to go to put out the desired spray volume on your acre length.
Application speed:
how fast you have to go to put out the desired spray volume on your acre length.

Speed = distance / time
so
(acre length) / (number of minutes for 1 acre)
Application speed:
how fast you have to go to put out the desired spray volume on your acre length.

(acre length) / (number of minutes for 1 acre)

In our example,
8712 ft (acre length)
\[ \div 45.5 \text{ minutes (time for 20 gal)} \]
= 191 ft / minute
Application speed:
how fast you have to go to put out the desired spray volume on your acre length.

Cool Applicator Trick:
Divide speed (feet per minute) by 88 to get miles per hour.

$191 \text{ ft/minute} \div 88 = 2.2 \text{ mph}$
Pacing yourself

Practice walking at application speed over a known distance.
Pacing yourself

In our example (191 ft/min), try measuring out 95 feet and walk it in 30 seconds…

Or 38 ft in 12 seconds (maybe close enough).
Pacing yourself

If this is too fast or too slow...

you can change your spray volume (g.p.a.)!
How often to calibrate (rule of thumb) –

- Beginning of the season
- When you change equipment
Filling the tank

- Based on tank size and g.p.a., figure out how many acres you can spray with one tank.
  
  \[ \text{4 gallon tank / 20 g.p.a.} = 0.2 \text{ acre} \]

- Use the right amount of chemical for that acreage.
  
  \[ 0.2 \text{ acre} \times 1 \text{ pt per acre (16 oz)} = 3.2 \text{ oz} \]

- Mix it up!
Keeping track
Dyes, GPS
ATV sprayers
Pressure
- nozzles
- boom height

Output
- flow rate
- overall spray volume

Speed
- spray width
- acre length
- pacing yourself
Spray width

12 nozzles x 20-inch spacing
= 240 inches (20 ft)
Output, each nozzle, 135 to 140 ml (~ 4 \frac{2}{3} oz)

- 3-nozzle total = 14 oz
- Multiply up for 12 nozzles \( \rightarrow 56\) oz
- 15-sec spray time x 4 \( \rightarrow 224\) oz/minute
- 224 oz/128 oz (1 gal) \( = 1.75\) gal / minute
Pressure
  • nozzles
  • boom height

Output
  • flow rate
  • overall spray volume

Speed
  • spray width
  • acre length
  • pacing yourself
Pressure
  • nozzles
  • boom height

Output
  • flow rate

Speed
  • spray width
  • acre length
  • pacing yourself
  • overall spray volume
Spray width

12 nozzles x 20-inch spacing
= 240 inches (20 ft)

43560 sq ft (acre) / 20 ft (spray width)
= 2178 ft acre length
ATVs usually have an ideal travel speed for a given terrain.

- Use low gear, high RPMs
- Find a sweet spot in 3 to 10 mph
- If no speedometer, time yourself over a known distance on site (or use GPS)
Estimate total spray volume based on ATV speed:

- 2178 ft (acre length)
- 5 mph = 440 ft/min

✓ 2178 ft ÷ 440 ft/min = 4.95 minutes
Estimate total spray volume based on ATV speed:

\[
\text{5 mph} = \frac{2178 \text{ feet}}{5 \text{ mph}} = 4.95 \text{ minutes}
\]
Estimate total spray volume based on ATV speed:

- 2178 ft (acre length)
- 5 mph = 440 ft/min
  - 2178 ft ÷ 440 ft/min = 4.95 minutes
- 1.75 gal / min
  - 1.75 gal/min X 4.95 min = 8.7 g.p.a.
Spot treatments

- For individual plants
- Can use nonselective herbicides
- Use a percent solution (i.e., 2% to 4% *Roundup*)
TeeJet XR ("Extended Range") nozzles
TeeJet XR 8004

Lower pressure
(15-20 psi)
Making a spray-to-wet treatment

• Spray to wet, not to run-off
• Practice applying on a known size plant (or patch)
• Teach the crew for consistency
Calibrating spray-to-wet?
5 ft

4 ft

~ 20 sq ft
8004 nozzle, 15 psi, 14 seconds
→ 160 ml (~5 oz) / 20 sq ft
→ 92 g.p.a.

~ 20 sq ft
To make spray-to-wet consistent, train the spray crew:

• Learn what spray-to-wet looks like
  – Memorize the application motion

• Measure (or estimate) individual plants
  – Categorize plants
The Weed Research and Information Center is an interdisciplinary collaboration that fosters research in weed management and facilitates distribution of associated knowledge for the benefit of agriculture and for the preservation of natural resources.

**WHAT'S NEW**

- WANTED: Cooperative Extension Weed Science Specialist
- Weeds featured in IPM News
- Annual Bluegrass Pest Notes **REVISED PUBLICATION**
- UC graduate student Moretti named University Medalist at Fresno State
- UC Davis weed science graduate student Kleist awarded CCST Fellowship

**CALENDAR**

- 2013, Jan 23-25: California Weed Science Society Annual Conference
- 2012, Feb 4-7: Weed Science Society of America Annual Meeting
- 2013, Mar 11-14: Western Society of Weed Science Annual Meeting