Roadside Chemical Usage Guidelines

2005 Edition

Updated October 2005

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The Importance of Roadside Vegetation Management

Keeping Nebraska's highways safe for those who travel includes the careful management and control of roadside vegetation. *("Vegetation" as referenced here includes ground cover, shrubs, brush, and trees.)* This includes, but may not be limited to, vegetation in the "clear zone" area, that part of the right of way that must remain free of obstructions.

Some examples are:

- Vegetation that hinders the visibility of traffic approaching any intersection.
- Vegetation overhanging or encroaching upon a right of way.

Note: *The State has the right to cut such vegetation overhanging its right of way to protect the traveling public. In the event of a tree trunk on private property with limbs overhanging state right of way, this may be done without the consent of the private owner since one does not have the right to encroach upon State right of way in any manner.*

Safety is foremost in our landscaping and design. Good common sense must prevail in the placement and/or maintenance of vegetation so safety hazards are not created or allowed to continue, once noted.

Nebraska Weed Info

Questions about the information in this section
should be directed to Mike Mattison at (402) 479-4878

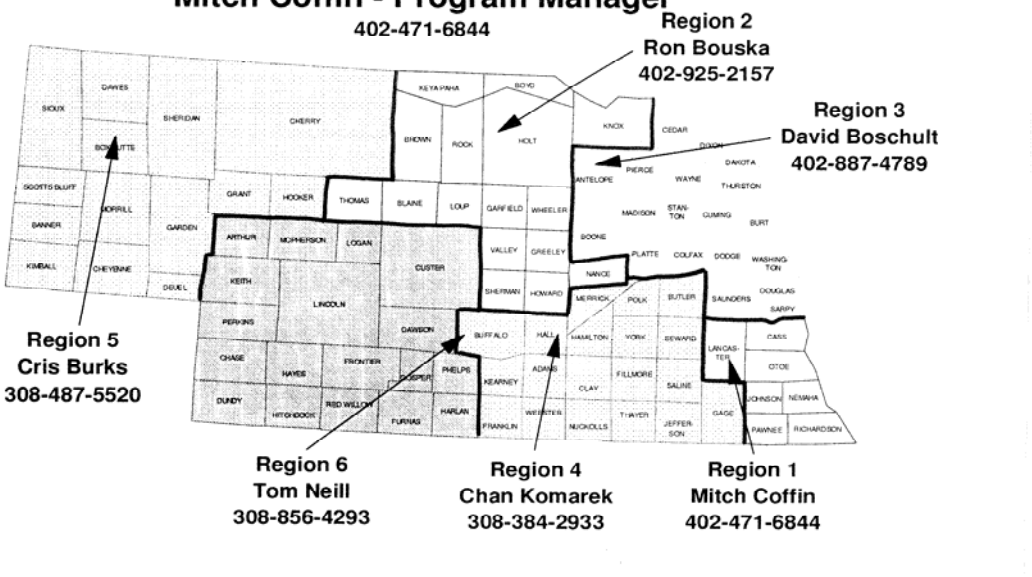
Email: mmattiso@dor.state.ne.us

(ALWAYS READ AND FOLLOW LABEL DIRECTIONS)

Nebraska Noxious Weeds

1.	Leafy Spurge	Statewide
2.	Musk Thistle	Statewide
3.	Canada Thistle	Statewide
4.	Plumeless Thistle	Statewide
5.	Diffuse Knapweed	Statewide
6.	Spotted Knapweed	Statewide
7.	Purple Loosestrife	Statewide
8.	Salt Cedar	Statewide
9.	Bindweed	County Option
10.	Tall Thistle	County Option
11.	Flodman Thistle	County Option
12.	Wooly Leaf Bursage	County Option
13.	Bull Thistle	County Option
14.	Scotch Thistle	County Option
15.	Houndstongue	County Option

Nebraska Department of Agriculture
Noxious Weed Program
Mitch Coffin - Program Manager
402-471-6844



Vegetation Management Websites

(for information, labels, and MSDS)

BASF..... www.agproducts.basf.com/inforesource/safetyresource.asp

Becker-Underwood ..... www.beckerunderwood.com

DowAgro ..... www.dowagro.com

Dupont ..... www.dupont.com/ag/vm

Monsanto ..... www.monsanto.com/ito

PBI Gordon ..... www.pbigordon.com

Riverdale..... www.riverdalecc.com

Syngenta..... .....www.syngenta.com

Van Diest Supply Co. ....www.vdsc.net

Labels and MSDS for all companies..... www.cdms.net/manuf/manuf.asp

Invasive Species Info ..... http://www.invasivespecies.gov

County Extension Offices..... http://www.ianr.unl.edu/email/About_Us/County_Offices/

UNL Institute of Agriculture & Natural Resources..... http://www.ianr.unl.edu/email/

Guidelines, Forms, and Sprayer Calibration Info

Questions about the information in this section
should be directed to Mike Mattison at (402) 479-4878
Email: mmattiso@dor.state.ne.us

(ALWAYS READ AND FOLLOW LABEL DIRECTIONS)

Certification of Chemical Applicators

- NDOR maintenance personnel who apply Nonrestricted Use Chemicals should be certified to do so.
- Maintenance personnel who apply Restricted Use Chemicals must be certified in Right-of-Way Pest Control to apply those chemicals.
- Maintenance personnel who apply a Restricted Use Chemical to treat for pocket gophers must be certified in Wildlife Damage Control.
- Maintenance personnel who apply any insect control, any nonrestricted chemicals, including fertilizer, to the lawns must be certified in ornamental and turf pest control.
- These rules also apply to the contractors that maintain any of our state operated rest areas, or apply chemicals on any NDOR right of way areas.

From: Nebraska Department of Agriculture

1. The Nebraska Pesticide Act, §2-2638(2), states in part that:

   "Any person who applies lawn care for hire or compensation, shall apply to the Department for a commercial applicator license regardless of whether such business applies to any restricted use pesticides."

2. Section 005.02A4 of the Nebraska Pesticide Act regulations defines that the Ornamental and Turf Pest Control category as:

   "…including commercial and noncommercial applicators using or supervising the use of restricted use or general use pesticides to control pests in the maintenance and production of **ornamental trees, shrubs, flowers, and turf**, including in and around structures, greenhouses, plant nurseries, golf courses, athletic fields, public or private grounds and turf farms."

Nebraska Department of Roads' employees who apply pesticides, either general use or restricted use pesticides, in the maintenance of ornamental trees, shrubs, flowers, and turf on roadside rest areas are, therefore, required to be certified as either commercial or noncommercial pesticide applicators in Nebraska.

Pesticide Application Report

To be completed by Commercial Pesticide Applicators who apply Restricted Use Pesticides in Nebraska. Ref. 40 C.F.R. §171.11(c)(7).

Date Report Filed:

Pesticide Applied By: *(Name of person and address of the maintenance yard)*				Pesticide Applied For: Nebraska Department of Roads PO Box 94759 Lincoln Nebraska 68509-4759
MONTH	**DAY**	**YEAR**	Time of Application A.M. ☐ P.M. ☐	Location of Application: *(Highway and Reference Post)*
Trade Name and EPA Registration Number of Pesticide Applied:				
Amount Applied:		% Active Ingredient:		Targeted Pest(s):
COMPLETE THIS SECTION IF DISPOSAL IS REQUIRED				
Type of Pesticide:		Amount:		
Method:		Location:		Specific Crop or Commodity Applied To: Turf-Lawn ☐ Roadside ☐
Additional Comments:				

DR Form 187a, Oct 05

Nebraska Department of Roads

Pesticide Applications Document

(To be completed annually for each pesticide)

DISTRIBUTION
White – Supervisor
Canary – Employee Safety Office
Pink - Employee

Date:	Pesticide to be Applied:		Restricted Use: ☐ Yes ☐ No
Supervisor:	Applicator:	Social Security No.:	Certified: ☐ Yes ☐ No

I have been given information on the use of the pesticide ..... for application on .....
(Identify target species)

I have been given the label and the Material Safety Data Sheets and have been given time to read them. Time was made for me to ask questions about the chemical. .....
(Signature of Applicator)

Method of Application:
☐ Backpack Sprayer ☐ Tank Sprayer ☐ Hand Spreader ☐ Other .....

Before being sent out to apply pesticides, the equipment to be used has been inspected and checked by .....
(Signature of person who checked equipment)

DR Form 187, May 95

Calibrating a Sprayer

From EC 130 Guide for Herbicide Use in Nebraska (1971)

By C. R. Fenster, L. R. Robison

Since most chemicals are applied in water, and at a recommended rate, it is important to know how much water the sprayer will deliver. Application rates vary with nozzle size, tank pressure, and speed of travel. Sprayers are usually calibrated on a small area and the water discharged calculated on gallon per acre basis.

To calibrate a boom-type sprayer:

1. Measure and stake 330 feet *(20 rods)* in a straight line.
2. Fasten a container to catch the spray on 2 or more of the nozzles.
3. Fill the sprayer with water and spray the 300 feet using the same pressure *(30 psi)* and speed used for spraying. **Uniform speed and pressure must be maintained.**
4. **Measure separately the water collected from each nozzle.** Average together the ounces of water collected from the nozzles.
5. Use the chart on the next page to determine the amount of water *(in gallons per acre)* being delivered.

To determine the amount of herbicide needed:

Read the Label

Use the recommended rate.

Divide the number of gallons the tank will hold by the previously calibrated gallons per acre of water the sprayer will apply to get the number of acres a tank will spray.

Example:

Assume the sprayer tank holds 150 gallons and from calibrating the sprayer, you have determined the sprayer will apply water at the rate of 25 gallons per acre.

$$\frac{\text{150 gallon tank}}{\text{25 gal/A}} = \text{6 acres 1 tank will cover.}$$

Determine the amount of commercial product needed per tankful of water.

Example for liquid formulation:

The recommended application rate on the label of herbicide you plan to use is 1 pound of active ingredient per acre. You also note the herbicide is formulated to have 4 pounds of active ingredient per gallon.

To determine the amount of herbicide to use in each tankful, divide pounds of active ingredient needed to be applied by the pounds of active ingredient per gallon of commercial product. Multiply the answer by the number of acres one sprayer tank will apply.

$$\frac{\text{1 lb/A application rate}}{\text{4 lb./gal.}}$$

= 0.25 gallon of herbicide for each acre

0.25 gallon x 6 acres = 1.5 gallons of commercial product for each tankful of water.

Example of wettable powder:

The label on a wettable powder reads 80W and recommends an application rate of 2 pounds per acre of active ingredient. To find the amount of commercial product to apply, divide rate of active ingredient to be applied per acre by the percent active ingredient of commercial material. Multiply this answer by the number of acres one sprayer tank will cover. *(80W means 80% active ingredient.)*

$$\frac{\text{2 lbs./A application rate}}{.80}$$

= 2.5 lbs. of commercial product per acre.

2.5 pounds per acre x 6 acres = 15 lbs. of commercial product for each tankful of water.

Amount of Water *(in Gallons per Acre)* Being Delivered

If the **Average** Ounces of Water is:	And if the distance between nozzles, or band width, in inches is:						
	7”	8”	12”	14”	16”	18”	20”
	Then the gallons of water per acre are:						
2	3.5	3.1	2.1	1.8	1.5	1.4	1.2
3	5.3	4.6	3.1	2.7	2.3	2.0	1.8
4	7.1	6.2	4.1	3.5	3.1	2.7	2.5
5	8.8	7.7	5.1	4.4	3.8	3.4	3.1
6	10.6	9.2	6.2	5.3	4.6	4.1	3.7
7	12.3	10.8	7.2	6.2	5.4	4.8	4.3
8	14.1	12.4	8.2	7.1	6.2	5.5	4.9
9	15.9	13.9	9.4	7.9	6.9	6.2	5.5
10	17.7	15.4	10.8	8.8	7.7	6.9	6.2
11	19.4	17.0	11.6	9.7	8.5	7.5	6.8
12	21.2	18.6	12.4	10.6	9.3	8.2	7.4
13	22.9	20.1	13.4	11.5	10.5	8.9	8.0
14	24.7	21.7	14.4	12.4	10.8	9.6	8.7
15	26.4	23.3	15.4	13.2	11.6	10.3	9.3
16	28.2	24.8	16.5	14.1	1`2.4	11.0	9.9
17	30.0	26.3	17.5	15.0	13.1	11.7	10.5
18	31.8	27.8	18.6	15.9	13.9	12.4	11.1
19	33.5	28.9	19.6	16.8	14.7	13.0	11.7
20	35.3	30.1	20.6	17.7	15.5	13.7	12.4
21	37.1	32.0	21.6	18.5	16.2	14.4	13.0
22	38.9	34.0	22.7	19.4	17.0	15.1	13.6
23	40.6	35.6	23.7	20.3	17.8	15.8	14.2
24	42.4	37.1	24.7	21.2	18.6	16.5	14.8
25	44.2	38.6	25.7	22.1	19.3	17.2	15.4
26	46.0	40.2	26.8	23.0	20.0	17.9	16.1
27	47.7	41.7	27.8	23.8	20.8	18.5	16.7
28	49.5	43.3	28.9	24.7	21.7	19.2	17.3
29	51.2	44.8	29.9	25.6	22.4	19.9	17.9
30	53.0	46.4	20.9	26.5	23.2	20.6	18.5
31	54.8	47.9	31.9	27.4	24.0	21.3	19.1
32	56.6	49.5	33.0	28.3	24.8	22.0	19.8
33	58.3	51.0	34.0	29.1	25.5	22.7	20.4
34	60.0	52.6	35.0	30.0	26.3	23.4	21.0
35	61.8	54.1	36.0	30.9	27.0	24.1	21.6
36	63.6	55.7	37.1	31.8	27.8	24.8	22.3
38	67.1	58.8	39.1	33.6	29.3	26.1	23.5
40	70.7	61.9	41.2	35.4	30.9	27.5	24.8
42	74.3	65.0	43.3	37.1	32.4	28.9	26.0
44	77.8	68.1	45.4	38.9	34.0	30.3	27.2
46	81.3	71.2	47.4	40.6	35.5	31.6	28.4
48	84.9	74.3	49.5	42.4	37.1	33.0	29.7
50	88.4	77.4	51.5	44.2	38.6	34.4	30.9
52	91.9	80.4	53.6	46.0	40.2	35.8	32.2
54	95.4	83.5	55.6	47.7	41.7	37.1	33.4
56	99.0	86.6	57.7	49.5	43.3	38.5	34.7
58	102.5	89.7	59.8	51.2	44.8	39.9	35.9
60	106.0	92.8	61.9	53.0	46.4	41.3	37.1
62			63.9	54.8	47.9	42.6	38.3
64			66.0	56.6	49.5	44.0	39.6
66			68.1	58.3	41.0	45.4	40.8
68			70.1	60.1	52.6	46.8	42.1
70			72.1	61.8	54.1	48.1	43.3
72			74.2	63.6	55.7	49.5	44.6
74			76.3	65.4	57.2	50.9	45.8
76			78.4	67.2	58.8	52.3	47.0
78			80.4	68.9	60.3	53.6	48.2
80			82.5	707	61.9	55.0	49.5
82			84.5	72.5	63.4	56.4	50.7
84			86.6	74.3	65.0	57.8	52.0
86			87.6	76.1	66.5	59.1	53.2
88			88.6	77.9	68.1	60.5	54.5
90			89.6	79.6	70.0	61.8	55.7
92			90.7	81.4	72.0	63.2	56.9
94			94.8	83.1	73.1	64.6	58.1
96			99.0	84.9	74.3	66.0	59.4
98			101.0	86.6	75.8	67.4	60.6
100			103.1	88.4	77.4	68.8	61.9

Calibration of Single Nozzle Sprayers

$$\left[\left(\frac{\text{Time to walk 100 ft.}}{\text{Time to collect 1 pint}} \right) \times \left(\frac{435.6}{\text{Spray Width in ft.}} \right) \right] \div 8 = \text{GPA}$$

Example: It takes you 23 seconds to walk 100 ft. at your normal walking pace spraying a band of pesticide 1 foot wide. The sprayer delivers 1 pint of liquid in 53 seconds. The pressure used should be within the correct nozzle pressure range to give a good pattern **without creating a fine, misting spray.** Enter the factors in this example into the formula to determine the sprayer's gallons per acre (GPA) delivery rate.

$$\left[\left(\frac{23 \text{ Sec.}}{53 \text{ Sec}} \right) \times \left(\frac{435.6}{1 \text{ ft.}} \right) \right] \div 8 = \text{GPA}$$

$$[\ (.43) \times (435.6)\ ] \div 8 = \text{GPA}$$

$$(187.31) \div 8 = \text{GPA}$$

$$23.41 = \text{GPA}$$

For Your Use

Walking time for 100 ft. (A) _____

$$\left[\left(\frac{\text{(A)}}{\text{(B)}} \right) \times \left(\frac{435.6}{\text{(C)}} \right) \right] \div 8 =$$

Time to collect 1 pint (B) _____

Spray width in ft. (C) _____

Operating Pressure _____

Nozzle type _____

My Sprayer's GPA _____

Refer also to the 2003 Nebguide No. G03-1511A, **Calibration of Sprayers (Also Seeders)** at **http://ianrpubs.unl.edu/farmpower/g1511.htm**

NebGuide

University of Nebraska Lincoln

IANR

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G03-1511-A

Calibration of Sprayers (Also Seeders)

Robert N. Klein, Extension Cropping Systems Specialist

Various methods for calibrating sprayers and seeders and related application information.

Applying the correct rate of a product is an important part of obtaining good results with both seeders and pesticide sprayers. With seeders too little seed reduces crop yields and increases weeds while too much seed increases costs and may reduce yields. With a pesticide application, too little product can mean poor control, while too much can mean crop injury, extra costs, and possible residue on the crop and/or carryover.

Many methods can be used to calibrate sprayers, including the ounce calibration and formula-based methods. With the ounce calibration method, 1/128 of an acre is sprayed and the spray is collected. When measured in ounces the amount collected would be equal to the number of gallons applied per acre since there are 128 ounces in a gallon. (For further information on this method, see NU NebGuide, *Fine Tuning a Sprayer with the "Ounce" Calibration Method,* G88-865.) Other methods involve using formulas which need to be remembered or recorded for easy use. These methods also may require converting some of the information you have.

The methods discussed in this NebGuide are simple relationships and do not require remembering formulas. However, you do need a general understanding of cross multiplication. The important thing is to be consistent: if you put an item on top of an equation on one side, the same item also goes on the top on the other side.

Three factors determine sprayer application rate:

1. Speed
2. Nozzle spacing
3. Nozzle output (determined by orifice size, pressure, and density of spray solution)

Where:

Speed = Length or distance covered divided by time
Nozzle spacing = Width
Nozzle output = The quantity applied/unit time

The following diagram shows how these three factors are related:

Speed = length or distance covered divided by time

Nozzle spacing (width) | Nozzle output = the quantity applied/unit time

For example, to determine speed:
1 mile per hour (mph) is:
1 mile (5,280 ft) in 1 hour (60 minutes)

$$\text{Or } 1 \text{ mph} = \frac{5{,}280 \text{ ft/hour}}{60 \text{ min/hour}} = 88 \text{ ft/min}$$

Problem 1. Determine speed in mph.

If we travel 440 feet (ft) in 30 seconds (sec), what is our speed in mph?

The objective is to determine the distance traveled in 60 seconds (1 minute) and divide by 88 (88 feet/minute is equal to 1 mph).

$$\frac{30 \text{ sec}}{440 \text{ ft}} = \frac{60 \text{ sec}}{D}$$ (D is the distance we are solving for in the equation)

We cross multiply to find the value of D
$30 D = 60 \times 440$
$30 D = 26{,}400$

$$D = \frac{26{,}400}{30}$$

D = 880 ft/60 sec

Since every 88 ft traveled/60 sec (1 min) is equal to 1 mph, we divide 880 by 88 to get 10 mph

Problem 2. Determine speed in mph.

If we travel 297 feet in 27 seconds, what is our speed?

$$\frac{27 \text{ sec}}{297 \text{ ft}} = \frac{60 \text{ sec}}{D}$$

$27 D = 60 \times 297$
$27 D = 17{,}820$

$$D = \frac{17{,}820}{27}$$

D = 660 ft/60 sec

Divide by 88 since 1 mph = 88 ft/60 sec (1 min)

$$\frac{660}{88} = 7.5 \text{ mph}$$

B-15

Problem 3. Determine speed in mph.

If we travel 660 feet in 1 minute and 15 seconds, what is our speed?

First, convert 1 minute and 15 seconds to seconds: 60 + 15 = 75 seconds

$$\frac{75\ (\text{sec})}{660\ (\text{ft})} = \frac{60\ (\text{sec})}{D}$$

$$75\,D = 39{,}600$$
$$D = 528$$

$$\frac{528}{88} = 6 \text{ mph}$$

Problem 4. Determine rate/acre.

If the sprayer is moving at 6 mph, the distance covered in one minute is 528 feet (6 mph x 88 ft/min = 528 feet).

To determine the area you cover with one nozzle in one minute if your sprayer has a 30-inch nozzle spacing:

Distance traveled 6 x 88 = 528 ft/min

30 in (2.5 ft) [ ]

Area sprayed = 1,320 sq. ft. (2.5 ft x 528 ft/min)

Collect the output of several nozzles and determine the average output per nozzle. All nozzles should be within 10 percent of the manufacturer's rating for that nozzle. For example an XR11003 delivers 0.3 gpm at 40 psi. If it delivers more than 0.33 gpm or 42.24 (128 x .33) ounces/min at 40 psi, the nozzle should be replaced. Any nozzle delivering 5 percent above or below the average delivery rate for all the nozzles should be replaced.

For this example, the average nozzle output is 32 oz per minute or

32 (oz/min) ÷ 128 (oz/gallon) = 0.25 gpm

What is the rate per acre? One way to calculate application rate without remembering a formula is to use a relationship: The amount applied and the area sprayed per minute are the same as the amount applied and the area sprayed per acre. R = gals/acre

	Minute Box Distance 6 x 88 = 528 ft		Acre Box
Nozzle Spacing 30 in ÷ 12 = 2.5 ft	0.25 gpm	=	R
	528 x 2.5 = 1320 sq ft		43,560 sq ft

From minute box $\frac{0.25}{1320} = \frac{R}{43{,}560}$ From acre box

1320R = 10,890 (0.25 x 43,560)

R = 8.25 gals/acre

Problem 5. Determine the acres sprayed per minute.

Travel distance in one minute = 616 ft
Nozzle spacing = 30 in (20 nozzles on sprayer)
Nozzle output = 64 oz/minute

What is travel speed? 616 ÷ 88 = 7 mph (Remember 88 ft/min = 1 mph)

What is sprayer width? 20 nozzles x 2.5 ft (30-inch spacing) per nozzle = 50 ft

What is application rate? $\frac{64\ \text{oz/minute}}{128\ \text{oz/gallon}} = 0.5$ gpm

	Minute Box Distance 616 ft		Acre Box
30-inch nozzle spacing (2.5 ft)	64 oz or 0.5 gpm	=	R
	1,540 sq ft		43,560 sq ft

$$\frac{0.5}{1{,}540} = \frac{R}{43{,}560}$$

$$1540R = 21{,}780$$
$$R = 14.14 \text{ gals/acre}$$

To determine the area covered by the sprayer in one minute:
1,540 sq ft/nozzle/minute
20 nozzles 1,540 x 20 ÷ 43,560 sq ft/A = 0.71 acre/minute

Problem 6. Determine nozzle size needed to achieve the operational goal.

Sprayer speed = 7 mph
Nozzle spacing = 20 inches
Application rate desired = 17 gpa
Nozzle flow rate = F

	Minute Box 7 x 88 = 616 ft		Acre Box
Nozzle Spacing $\frac{20\text{ in}}{12\text{ in/ft}} = 1.67$ ft	F = gpm	=	17 gpa
	1,029 sq ft		43,560 sq ft

$$\frac{F}{1{,}029} = \frac{17}{43{,}560}$$

$$43{,}560\,F = 17{,}493$$
$$F = 0.40 \text{ gpm} \quad \text{or XR8004* at 40 psi}$$

If we need 0.40 gpm, by design an XR8005* will give 0.5 gpm at 40 psi. Output varies by the square root of the pressure.

For example: $\frac{\sqrt{40\,psi} = 6.32 \text{ psi}}{\sqrt{10\,psi} = 3.16 \text{ psi}} = 2$

Raising the pressure from 10 to 40 psi (4 times $\sqrt{4} = 2$) doubles output.

Therefore we need to reduce output to 0.40 gpm which is 80 percent of the 0.5 gpm that an XR8005 puts out at 40 psi.

$\sqrt{40} = 6.32 \times 0.8 = 5.056$

$\sqrt{P}$

To solve for "P" take the result multiplied by itself.
5.056 x 5.056 = 25.6 psi
an XR8005 at 25.6 psi will give you 0.40 gpm

*Selected from TeeJet Nozzle Booklet by Spraying Systems.

Problem 7. Calibrating a hand sprayer.

First fill sprayer with water to a known level, a mark you can later refill to accurately. (Tip: It's best to spray a test area over concrete so you can see the evenness of application.)

Spray test area 100 sq ft = 10 ft x 10 ft
or 250 sq ft = 10 ft x 25 ft
or 500 sq ft = 10 ft x 50 ft or 20 ft x 25 ft

Refill sprayer to same level as before, measuring amount of water it takes to refill sprayer.

If the pesticide recommendation is for 2 liquid ounces of product per 1,000 sq ft, the amount to include per 1,000 sq ft would be 1/4 cup or 4 tablespoons or 12 teaspoons. (See Weights and Measures Conversions on page 4.)

If during the test, 28 oz of water were applied over 250 sq ft, how much water and pesticide should be added to a 3 gallon sprayer?

The amount of water you applied in test area $\frac{28 \text{ oz}}{250 \text{ sq ft}} = \frac{\text{V for volume}}{1{,}000 \text{ sq ft}}$ How much water you will apply per 1,000 sq ft

250 V = 28,000
V = 112 ounces or ÷ 32 (ounces/qt) =

3.5 qt of water per 1,000 sq ft

This indicates that 2 oz of pesticide should be added for every 3.5 qt of sprayer capacity.

With a 3-gallon sprayer, 12 qt (3 x 4 qt/gal) of water should be added to the sprayer tank.

$$\frac{2 \text{ oz}}{3.5 \text{ qt}} = \frac{\text{P for Pesticide}}{12 \text{ qt}}$$

3.5 P = 24
P = 6.86 oz or 0.86 cup (8 oz/cup)

6.86/8 = 0.86 cup The amount of pesticide to add to a 3-gallon sprayer

Problem 8. Determining the density of spray solution.

The rate at which a fluid flows through a spray orifice varies with its density. Since all the tabulations are based on spraying water, which weighs 8.34 lbs per U.S. gallon, conversion factors must be used when spraying solutions which are heavier or lighter than water. To determine the proper size nozzle for the solution to be sprayed, first multiply the desired GPM or GPA of solution by the water rate conversion factor. The conversion factors are the square root of specific gravity. (See Weights and Measures Conversion chart on page 4 for some common fertilizers).

For example, the specific gravity of 28% nitrogen, which weighs 10.65 lbs/gal, is:

$$\frac{10.65 \text{ (Wt of 28-0-0/gal)}}{8.34 \text{ (Wt of water/gal)}} = 1.28 \text{ specific gravity}$$

Conversion factor for 28-0-0 fertilizer or 28% nitrogen is

$\sqrt{1.28} = 1.13$

Weight of Solution	*Specific Gravity*	*Conversion Factors*
7.0 lbs per gallon	0.84	0.92
8.0 lbs per gallon	0.96	0.98
8.34 lbs per gallon - Water	1.00	1.00
9.0 lbs per gallon	1.08	1.04
10.0 lbs per gallon	1.20	1.10
10.65 lbs per gallon - 28% nitrogen	1.28	1.13
11.0 lbs per gallon	1.32	1.15
11.06 lbs per gallon - 32% nitrogen	1.33	1.15
12.0 lbs per gallon	1.44	1.20
14.0 lbs per gallon	1.68	1.30

Example of using the conversion factor:
Desired application rate is 20 GPA of 28% N.
GPA (solution) x Conversion factor = GPA (water)
20 GPA (28%) x 1.13 = 22.6 GPA (water)
A nozzle size should be selected to supply 22.6 GPA of water at the desired pressure, speed, and nozzle spacing.

Problem 9. Determining the density of a spray solution.

In this example, the following has been recommended for an ecofallow corn field:

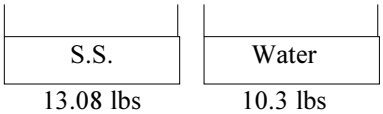
75 lbs of nitrogen from 28% UAN
Density of 28% N = 10.65 lbs/gal
10.65 x .28 = 2.982 lbs N/gal

$$\frac{75 \text{ lbs N}}{2.982 \text{ lbs N/gal}} = 25.15 \text{ gal of 28\% solution}$$

Ingredient	*Amount*	*Gallons*
28% Nitrogen	75 lb N	25.151
Balance Pro	2.0 oz	0.016
Fultime	2.25 qt	0.563
Gramoxone Extra	2 pt	0.250
Crop Oil Concentrate	1 qt	0.250
2,4-D 6 LVE	1/2 pt	0.063
		26.293 or 26.3 gal/acre

To determine how this will spray out and what gallonage of water is needed to get 26.3 gal/acre of this spray solution, three steps are required:

1. To determine specific gravity weigh an equal amount of the spray solution and an equal amount of water.



Determine specific gravity weight of spray solution:

$$\frac{13.08 \text{ lbs (wt of spray solution)}}{10.3 \text{ (wt of water)}} = 1.27 \text{ specific gravity}$$

2. Determine conversion factor $\sqrt{1.27} = 1.13$
3. Determine the quantity of water to calibrate sprayer:
Spray Rate x Conversion Factor = Water Amount Equivalent
26.3 gal/acre x 1.13 = 29.6 gal/acre
Now you need to calibrate the equipment to apply 29.6 gallons of water per acre.

Problem 10. To calibrate a seeder.

How may pounds of seed are needed to plant 18 seeds/ft in a row with 10-in spacing. Seed size is 15,000 seeds/lb and seed is collected for 500 ft.

To determine pounds of seed needed per acre:

$\frac{12 \text{ in/ft}}{10 \text{ in/row}} = 1.2$ $\quad 1.2 \times 43{,}560 \text{ ft}^2/\text{A} = 52{,}272$ ft of row/acre

52,272 x 18 seeds/ft row = 940,896 seeds/acre ÷ 15,000 seeds/lb = 62.7 lb/A

NOTE: Reference to commercial products is made with the understanding that no discrimination is intended and no endorsement by University of Nebraska Cooperative Extension is implied.

Determine area seeded with one opener on one acre:

10 in per row or $\frac{10 \text{ in}}{12 \text{ in/ft}} = 0.83$ ft

	Test Box 500 ft long		Acre Box
	Wt for weight of seed calibrated	=	62.7 lb seed/acre
	415 sq ft (500 x .83)		43,560 sq ft

Then cross multiply:

$\frac{\text{Wt}}{415} = \frac{62.7}{43{,}560}$

43,560 Wt = 26,020.5 (62.7 x 415)

Wt = 0.6 lb/opener or 9.6 oz/opener

Weights and Measures Conversion

Weight
16 ounces = 1 pound = 453.6 grams
1 gallon water = 8.34 pounds = 3.78 liters
1 short ton = 2,000 lbs
1 long ton = 2,240 lbs
1 cubic foot water = 62.4 lbs

Liquid Measure
1 fluid ounce = 2 tablespoons = 29.57 milliliters
1 tablespoon = 3 teaspoons = 14.79 milliliters
1 cup = 16 T = 8 oz = 236.583 milliliters
16 fluid ounces = 1 pint = 2 cups
8 pints = 4 quarts = 1 gallon

Dry Measure
1 ounce = 28.3495 grams

Length
1 inch = 2.54 centimeters
3 feet = 1 yard = 91.44 centimeters
16.5 feet = 1 rod
5,280 feet = 1 mile = 1.61 kilometers
320 rods = 1 mile

Area
9 square feet = 1 square yard
43,560 square feet = 1 acre = 160 square rods
1 acre = 0.405 hectare
640 acres = 1 square mile
1 hectare = 2.47 acres

Speed
88 feet per minute = 1 mph
1 mph = 1.61 km/h
1 mph = 0.477 meter/sec

Volume
27 cubic feet = 1 cubic yard
1 cubic foot = 1,728 cubic inches = 7.48 gallons
1 gallon = 231 cubic inches
1 cubic foot = 0.028 cubic meters
Volume of sphere = D^3 x 0.5236

Common Abbreviations and Terms Used
GPM = gallons per minute
GPA = gallons per acre
psi = pounds per square inch
mph = miles per hour
RPM = revolutions per minute
GPH = gallons per hour
FPM = feet per minute
T = Tablespoon
t = teaspoon

Circles
Diameter x 3.1416 = circumference
Radius^2 x 3.1416 = area

Spraying Systems Droplet Size in Microns
Very Fine = 153 and less
Fine = 154 - 241
Medium = 242 - 358
Coarse = 359 - 451
Very coarse = 452 - 740
Extensively coarse = 741 +

Fertilizer Facts
Pounds per gallon of liquid fertilizer at 60°F

10-34-0	11.40
11-37-0	11.60
7-21-7	11.00
28-0-0	10.65
28-0-0	10.65
32-0-0	11.06
82-0-0	5.15
12-0-0-26	11.50

1 ppm = 1 second in 12 days or 0.013 ounces in 100 gallons
or about 8/10 of 1 teaspoon in 1,000 gallons
1 ppb = 1 second in 32 years or 0.013 ounces in 100,000 gallons
or about 8/10 of 1 teaspoon in 1,000,000 gal
1 ppt = 1 second in 320 centuries
1 pint of water in ocean = 5,000 molecules in any pint of water
1 psi = 2.31 ft
1 foot of lift of water = 0.433 psi
452 gpm = 1in/1 acre/1 hr

	Lbs/bu	*Moisture %*
Corn	56	15.5
Soybeans	60	13.0
Grain sorghum	56	14.0
Wheat	60	13.5
Sunflower	25	10.0

Cu ft x 0.8 = bushel of grain
Cu ft x 0.4 = bushel of ear corn

1 horsepower = 550 ft lbs/sec
= 33,000 ft lbs/min
= 746 watts

File under: FARM POWER & MACHINERY
B-15, Machinery
Issued June 2003, 2,000

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Elbert C. Dickey, Dean and Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

Chemicals and Vegetation Control Uses

Questions about the information in this section
Should be directed to Mike Mattison at (402) 479-4878
Email: mmattiso@dor.state.ne.us

(ALWAYS READ AND FOLLOW LABEL DIRECTIONS)

Chemical Additives and Accessories

Dye	Becker Underwood – Tablets – Liquid & Water Soluble Packets
Wetting Agent	Must be non-ionic - Premier – 90
Drift Control	Gardian

Insect Control

Insect Control – Lawns

Billbug & Webworm	Sevin – Eight – Deltagard T&O Gran. or Tempo SC Ultra
Spider Mites	Kelthane – Soapy Water
Grubs	Merit or Mach II – *Apply June 10 to July 10*

Insect Control – Right of Way

Eastern Tent Caterpillar	Tempo SC Ultra – Sevin or Eight
	Non-chemical – Dipel
Grasshoppers	Tempo SC Ultra – Same as tent caterpillar
Mosquitoes	Adults – Malathion
	Larvae – Non-chemical – Minnows, BTI briquettes

General Vegetation Control

Guardrail Vegetation Chemicals

1. Sahara – DG herbicide at 12-15 lbs. per acre. Add 1 quart wetting agent per 100 gallons of water. You need very good agitation in the tank. *(Sahara – DG is a pre-mix of Arsenal and Karmex)* If pigweed is a problem, add Pendulum at 5-6 lbs. per acre. If Kochia has emerged, add 1 quart of Vanquish WDG/acre.
2. Wetting agents that work well are:
   A. Premier – 90+ Gardian Drift Control
3. For non-residual use:
   A. Roundup Pro, Quik Pro
   B. Finale

Weed Control – Lawns

Pre-emergent – Balan & Barricade

Broadleaf Weeds – Trimec or Mecamine “D”

Weed Control – Right of Way

General – Broadleaf	2-4-D Amine, Veteran – 720 (Banvel)
Leafy Spurge	See Pages 18 and 19
Musk Thistle	Telar & 2-4-D – See Page 17
Guardrail	Arsenal & Karmex – DF, Sahara, Roundup Pro, Quik Pro
In Joints	Hyvar X Roundup Pro, Quik Pro
Wet Ditches	Rodeo, Habitat
Under Asphalt	Casoron 10G
In Trees & Shrubs	Casoron 4G – November thru March
Grass in Trees & Shrubs	Over the Top with Poast or during the growing season Fusilade 2000

Seasonal Brush Control

Spring – Summer	Spike 20P Granules, Pronone Power Pellets
August 1 to September 15	Krenite-S – See Below

Use the following recipe for Aug-Sept brush control: Good Coverage = Good Control

100-Gallon Mix

1. 1 Quart Gardian
2. 1 Quart JLB Oil Plus
3. 1½ Gallons Krenite-S
4. 1 Quart Garlon-4
5. Use Good Pressure *(50 to 80 psi)*

Garlon-4	Van Diest Supply	(800) 652-9306
	Chemtrol	(913) 342-3006

Cut Stump See “Trees & Stump Control” Page 22

Quality Thistle Control for Back-Pack Spraying

1. Mix 1 ounce Telar in 1 gallon of water + 1 ounce wetting agent. Use a 1 gallon clear plastic container and mark it ***Telar mixture.***
2. To a 3-gallon back-pack sprayer, add the following:
   A. 4 fluid ounces of Telar mixture
   B. 1 ounce Premier 90
   C. 2 ounce 2-4D Amine
   D. ¾ to 1 ounce dye
   E. Fill with water
3. For Canada Thistle, use 8 fluid ounces of the Telar mixture.
4. Cover entire plant with spray, even the flower head.

Escort for Musk Thistle

per 100-gallon mix

1. ½ oz. Escort
2. 1 Qt. of 2, 4-D Amine
3. 1 Qt. of Wetting Agent – Premier 90
4. 1 Qt. Gardian Drift Control
5. Spray to wet

Leafy Spurge Alternate Recipe #1990

1. The recipe is based on a spray rate of 30 Gal./Acre
2. To 100 gallons of water, add:
   A. 1½ gallons of Crossbow
   B. +2 Quarts Premier 90
   C. + 16 oz. of Dye
   D. 2 Quarts Gardian Drift Control
3. Spray the entire patch, and spray to include some runoff.
4. This mixture may be used spring and fall.

Leafy Spurge Alternate Recipe #1991

1. The recipe is based on a spray rate of 30 Gal./Acre.
2. To 100 gallons of water, add:
   A. 2 Quarts of Garlon 4
   B. 2 Quarts of 2-4,D Low Volatile Ester
   C. 2 Quarts of Premier 90
   D. 16 oz. of Dye
   E 2 Quarts Gardian Drift Control
3. Spray the entire patch, and spray to include some runoff.
4. This mixture may be used spring and fall.

Leafy Spurge Alternate Recipe #1995

1. The recipe is based on a spray rate of 30 Gal./Acre.
2. To 100 gallons of water, add:
   A. 3 Quarts of Vanquish
   B. +3-3½ Quarts of 2,4-D Amine
   C. +2 Quarts Premier 90
   D. +16 Oz. of Dye
   E. +17 Lbs. Ammonium Sulfate
3. Spray the entire patch and spray to include some runoff.
4. This mixture may be used spring and fall.

Leafy Spurge – Fall Only
Per Acre – Handgun Operations

1. 8 oz. Plateau
2. 4 oz. 2,4-D – Amine (Weeder 64)
3. 2 Quarts Methylated Seed Oil (MSO) – Sold as SOY-STIK

Spray to wet

Calibrate the handgun and apply this amount per acre.

Bindweed

Use the following recipe for Bindweed:

100 Gallon Mix

1. Per 100 Gallon
2. 1 Pint Vanquish
3. 1 Quart Premier 90
4. 1 Quart Gardian Drift Control

Spray to wet

Wetlands Noxious Weed Control and Brush Control

The Department of Roads now owns many wetlands across Nebraska. The wetlands are not free from Noxious Weeds and invading Cottonwoods. The two noxious weeds that are the most common in the wetlands are Purple Loosestrife and Canada Thistle with an occasional patch of Leafy Spurge in the upland portion of the wetlands.

The County Weed Control Authorities may call your attention to these noxious weeds and want to spray them or urge you to get in there and spray these weeds or you may notice these weeds through your own vigilance.

Do not spray in the wetlands on your own. Call the Environmental Permits Unit at (402) 479-4418 and talk it over with the Manager or the Biologist in charge that wetland.

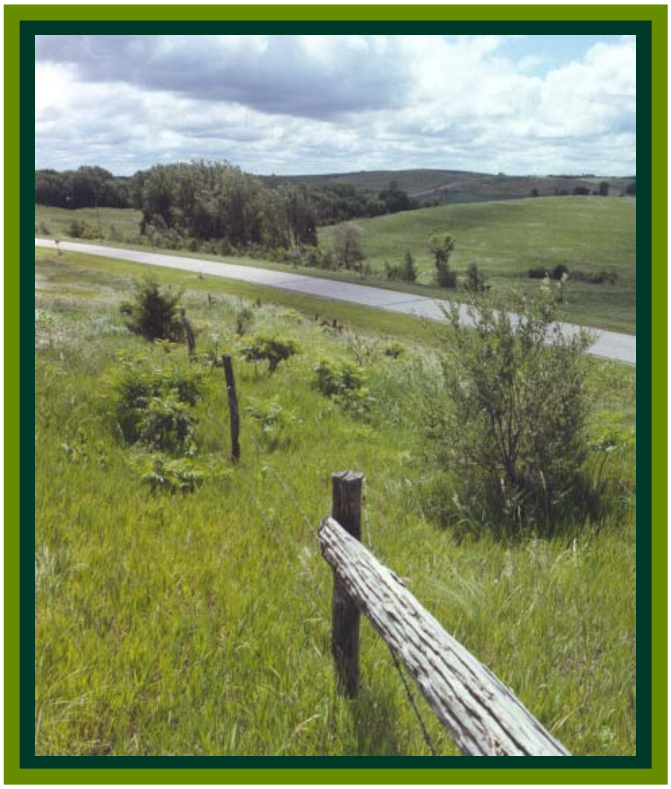
Wetland Volunteer Tree & Noxious Weed Control

Recipe for a three-gallon backpack sprayer.

1. For a three-gallon backpack sprayer, add the following:
    A. 1 Gallon of Water
    B. 6.25 fluid ounce of Rodeo
    C. 2 Ounces Premier 90 Wetting Agent
    D. 1 Ounce of Dye
    E. Add 2 more Gallons of Water
2. Spray to wet the entire plant
3. The solution may also be made up in bulk.

This recipe is good for Volunteer Trees, Purple Loosestrife, and Canada Thistle in our wetlands.

Tree & Stump Control



Questions about the information in this section
should be directed to Mike Mattison at (402) 479-4878
Email: mmattiso@dor.state.ne.us

ALWAYS READ AND FOLLOW LABEL DIRECTIONS

Cut Stump Herbicides for Fall & Winter

For Above Freezing Temperatures:

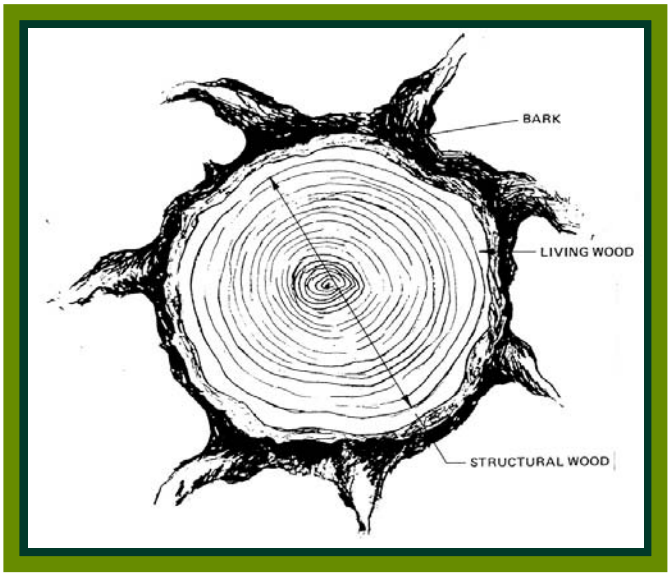
A. 2-4-D Amine
B. Roundup – Pro

For Below Freezing Temperatures:

A. Pathway
B. Krenite – S
C. Tordon – RTU
D. Pathfinder II

Cut Stump Treatment for Stumps Over 3” in Diameter

- Treat the Living Wood Only – Treat Immediately After Cutting
- Stumps that 3” and Under, Cover the Entire Stump Immediately



Red Cedar Control for Cedars Three Foot and Smaller

100 Gallon Mix

1. 2 Ounces of Escort
2. 1 Pint of “Silenergy”
3. Spray to Wet – from Spring greenup to first frost
4. Symptoms are slow to appear – may take the entire growing season for a complete kill.

Call if you have questions, (402) 479-4878, or email Mike Mattison.

Tree Control with Dormant Basal Treatment

- Spray entire trunk from knee high to the ground.
- Spray to **wet only** – we do not want runoff.
- Wear appropriate clothing:
    - Rubber Boots
    - Plastic Gloves
    - Disposable Coveralls

American Cyanamid has provided an excellent brush control recipe. This can be used in backpack sprayers or hand sprayers. The recipe is as follows:

5% stalker + 15% Garlon 4 + 82% basal oil carrier – the breakdown is as follows:

Per Gallon – 128 oz.	**Per 3 Gallon – 384 oz.**	**Per 5 Gallon – 640 oz.**
3% stalker = 4 oz.	12 oz.	20 oz.
15% Garlon 4 = 19 oz.	57 oz.	96 oz.
82% basal oil = 105 oz.	315 oz.	524 oz.

The basal oil is carried by Van Diest as J.L.B. oil plus.

OR

Diesel can be used as the oil-based carrier.

The recipe says the basal treatment should be made to the lower 12 to 18 inches of the tree trunk –approximately **knee high down to the ground**. Spray to wet – runoff is not necessary and only wastes the mix.

Areas that are treated with this basal method will have dead brush next year and can be a scheduled cleanup event.