# APPENDIX K <br> CALIBRATIONS, CALCULATIONS, \& CONVERSIONS <br> SPRAYER CALIBRATIONS AND CALCULATIONS ${ }^{1}$ 

TABLE K-1. SPRAYER CALIBRATIONS AND CALCULATIONS

| Calculation | Example | Formula |
| :---: | :---: | :---: |
| 1. Determining the Gallon per Minute (GPM) required of nozzles to achieve a given Gallon per Acre (GPA) | Example 1 <br> You want an output of 20 GPA. Your nozzles are 20 feet apart. Your field speed is 5 MPH . How much do you need to collect from each nozzle to achieve 20 GPA? $\begin{aligned} & \frac{20 \text { GPA } \times 5 \mathrm{MPH}}{5940} \times 20=\frac{2000}{5940} \\ & =0.336 \text { GPM per nozzle } \end{aligned}$ <br> Example 1a - Convert Gallons per Minute (GPM) to Ounces per Minute (OPM) <br> From Example 1 you have collected 0.336 GPM from each nozzle. $0.366 \times 128=43 \text { OPM per nozzle }$ <br> Example 1b - Convert OPM to GPM <br> You have collected 43 OPM from each nozzle. <br> 43 OPM $/ 128=0.336$ | Formula 1 $\frac{G P M=G P A \times M P H \times W}{5940}$ <br> GPM = Gallons per minute from one nozzle <br> GPA = Gallons per acre <br> W = nozzle spacing (inches) or; <br> = spray width (inches) if using a broadjet or; <br> = row spacing (inches) divided by the number or nozzles per row. <br> MPH = Field speed in Miles Per Hour <br> $5940=$ a constant <br> Formula 1a $\text { OPM = GPM x } 128$ <br> Formula 1b <br> GPM = OPM / 128 |
| 2. Determining GPA when given nozzle GPM, spacing between nozzles and field speed | Example 2 <br> Nozzle spacing $=20$ ". Field speed $=5 \mathrm{MPH}$. You collected liquid from all of the nozzles for one minute and obtained an average of 51 ounces per nozzle. Convert 51 OPM to GPM <br> 51 OPM / $128=0.398$ or 40 GPM per nozzle. $\begin{aligned} & \frac{0.398 \mathrm{GPM} \times 5940}{5 \mathrm{MPH} \times 20}=\frac{2364.12}{100} \\ & =23.64 \text { or } 24 \mathrm{GPA} \end{aligned}$ | Formula 2 $\text { GPA }=\frac{G P M \times 5940}{M P H \times W}$ |
| 3. Determining required speed when you know GPA, GPM and spacing between nozzles or broadjet swath | Example 3a <br> Nozzle output = 10 GPM. Swath width $=35$ feet ( 420 inches). <br> Desired GPA $=30$ GPA. What speed do you need to be traveling to achieve 30 GPA? $\begin{aligned} & \frac{10 \mathrm{GPM} \times 5940}{30 \mathrm{GPA} \times 420}=\frac{59,400}{12,600} \\ & =4.7 \text { or } 5 \mathrm{MPH} \end{aligned}$ <br> *Broadjet Example: If you had nozzles that were 20 inches apart and GPM was 0.40 GPM, the answer would be 3.96 or 4 MPH . <br> Example 3b <br> You want 30 GPA with a field speed of 7 MPH and nozzle spacing is 30 inches. Using formula \#1, you determine that you need to collect 1 GPM from each nozzle. When you check the nozzles, the output is actually 1.5 GPM. You can either change the nozzles or adjust your field speed to achieve 30 GPA. $\begin{aligned} & \frac{1.5 \mathrm{GPM} \times 5940}{30 \mathrm{GPA} \times 30 \text { inches }}=\frac{8,910}{900} \\ & =9.9 \text { or } 10 \mathrm{MPH} \text { as the new field speed } \end{aligned}$ | Formula 3 $\frac{\text { GPM } \times 5940}{30 \text { GPA } \times 420}$ |
| 4. How much area can my sprayer cover (acres)? | Example 4 <br> Your sprayer is calibrated at 30 GPA. You have a sprayer with a 500 gallon tank. How many acres can you treat with 500 gallons? How many can you treat with 250 gallons? | Formula 4 $\frac{\text { Volume in tank }}{\text { GPA }}=\text { Acres Treated }$ |
| 5. How much total solution do you need in order to spray a given acreage? | Example 5 <br> You want to spray 10 acres and your sprayer is calibrated to 25 GPA. How much total solution do you need in your sprayer tank? $10 \text { acres } \times 25 \text { GPA }=250 \text { gallons }$ | Formula 5 <br> Acres to spray x GPA = Gallons required |
| 6. How much pesticide, dry or | Example 6a <br> Your sprayer can treat 30 acres and the label calls for a rate of 1 pint | Formula 6 |

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| Calculation | Example | Formula |
| :---: | :---: | :---: |
| liquid, do you add to the tank when rate is given on a per acre basis? | per acre. How much pesticide do you add to the tank? <br> 30 acres $\times 1$ pint $=30$ pints or $33 / 4$ gallons <br> (30 / 8 pints per gallon) <br> Example 6b <br> Using the information in Example 6a, you are using dry ingredients in ounces per acre. How much pesticide do you add to the tank to treat 30 acres? <br> 30 acres $\times 10$ ounces $=300$ ounces or <br> $183 / 4$ pounds (300 / 16 oz . per pound) | Acres treated $x$ labeled rate = Amount of pesticide to add to the tank |
| 7. How much liquid pesticide do you add to the tank when the rate is given according to pounds of active ingredient (a.i.) per acre? | Example 7a <br> A rate of $3 \mathrm{lbs} /$ acre of the active ingredient (a.i.) is recommended. This pesticide contains 8 lbs . of a.i. per gallon of formulation. <br> 3 lbs. per acre / 8 lbs. a.i. per gallon $=0.375$ gallons per acre or $11 / 2$ quarts per acre $(0.375 \times 4)$ or 3 pints per acres $(0.375 \times 8)$ <br> Example 7b <br> You have calibrated a 300 gallon sprayer. It can spray 7.5 acres per tank at 40 GPA. A recommendation indicates to apply $1 / 2$ pound a.i. per acre. The label indicates that it contains 2 pounds of a.i. per gallon. How much pesticide will you add to the tank to spray 7.5 acres? $\frac{0.50 \mathrm{lb} \text { a.i./acre }}{2 \mathrm{lb} \text { a.i. } / \text { gallon }}=0.25 \text { gallon (1 quart)/ac }$ <br> 7.5 acres/tank $\times 1$ quart per acre $=7.5$ quarts | Formula 7 <br> Labeled Rate Per Acre = Gallon amount to apply <br> Amount of a.i. per gallon |
| 8. How much dry pesticide do you apply per acre when the rate is given as a percentage of a.i.? | Example 8 <br> A recommended rate of 0.2 lbs . a.i./acres of a $25 \%$ wettable powder (WP) is recommended (One pound of formulation contains 0.25 lbs . a.i.) $\frac{0.2 \mathrm{lbs} \text {. per acre }}{0.25 \mathrm{lbs} . \text { a.i. }}=0.80 \mathrm{lb} \text { formulation /ac }$ <br> To convert to ounces: 0.80 lbs . x 16 ounces/lbs. (dry) $=12.8$ ounces per acre | Formula 8 $\frac{\text { Recommended rate }}{\%}=\mathrm{Ibs} \text {. of formulation/acre }$ |
| 9. Check the output of boom nozzles. | All nozzles across a boom need to be applying roughly the same amount of liquid within a certain error range (usually 5\% on either side of the average). Clean and/or replace any nozzles that fall outside of your given error range. <br> Example 9 <br> You have a 10 nozzle boom and you have collected from under each nozzle for one minute. You noted the following nozzle outputs <br> Average Nozzle Output $=441$ oz. $/ 10$ nozzles $=44.1 \mathrm{oz}$. For 5\% error: 44.1 oz . $\times 0.05=2.2 \mathrm{oz}$. to add and subtract from the average. <br> Error range (5\%) on either side of the average $=41.9 \mathrm{oz}$. to 46.3 oz . Nozzles 3, 7, \& 8 needs to be cleaned or replaced. Note: If a nozzle's output is lower, it may be plugged and only need to be cleaned. Repeat this exercise until all nozzles fall with the error range. | Formula 9 <br> Nozzle 1 output + nozzle 2 output + etc. <br> Number of nozzles on the boom <br> = Average Nozzle Output <br> Average Nozzle Output x $0.05=$ amount to add and subtract from the Average Nozzle Output to make an error range of $5 \%$. |
| 10. Adding Adjuvants to the Spray Tank | Pesticide labels often suggest adding adjuvants to the spray mix, listing the rate of the adjuvant in terms of percentage of the spray mix, volume per acre, or volume per quantity of spray mix <br> Example 10a - When the rate is expressed as a \% of the spray mix <br> Total spray mix $=500$ gallons. Adjuvant rate is $1 \%$ of the finished spray volume. $0.01 \times 500=5$ gallons of adjuvant added along with pesticide to make a 500 gallon solution <br> Example 10b - When the rate is expressed as a volume per acre. <br> Your sprayer is calibrated to 30 GPA and you plan on using 300 gallons of solution. An adjuvant calls for a rate of 1 pint per acre. <br> 300 gallons $/ 30$ GPA $=10$ acres $\times 1$ pint per acre $=10$ pints of adjuvant added along with pesticide to make a 300 gallon solution. | Formula 10a $\begin{gathered} \frac{\% \text { of spray mix x gallons of spray mix }}{100} \\ =\text { Gallons adjuvant needed } \end{gathered}$ <br> Formula 10b <br> Adjuvant needed $=$ <br> Adjuvant rate x acres to be treated <br> Formula 10c <br> Adjuvant needed $=$ <br> $\frac{\text { Rate per } 100 \text { gallons }}{100} x$ gallons of spray mix |

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| Calculation |  |  |  |  |  |  |  | Formula |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |
| 11. Dilution Rule | Example 11 <br> How much of a $50 \%$ concentrate is needed to make 100 gallons of a $1.5 \%$ spray? $50 \times \text { Volume } 1(\mathrm{~V} 1)=1.5 \times 100$ $\text { V1 = } 3 \text { gallons }$ <br> The final mixture (Volume 2 or V 2 ) is the amount of the concentrate (V1) plus the required amount to make up to V 2 . If $\mathrm{V} 1=3$ gallons and the required amount is 100 gallons, add 97 gallons of water to 3 gallons of concentrate. |  |  |  |  |  |  | Formula 11 $\mathrm{C} 1 \times \mathrm{V} 1=\mathrm{C} 2 \times \mathrm{V} 2$ <br> C1 $=$ \% of a.i. in concentrate <br> V1 = quantity of concentrate needed <br> $\mathrm{C} 2=$ \% a.i. desired in final mixture <br> V 1 = quantity of final mixture <br> It is important that the units used are all the same: i.e. percent $x$ pounds $=$ percent $x$ pounds or percent x volume $=$ percent x volume |
| Hints on Percentage Mixing | A pesticide label may tell you to mix up a concentration or percentage of the product in water. For example, mix 1 part of the pesticide concentrate and 99 parts water. This makes a 1 percent mixture. Since there are 128 fluid ounces in one gallon, 1.28 ounces of a concentrate mixed into 1 gallon of water will make approximately a 1 percent mixture (Hint: 1 tablespoon is about $1 / 2$ ounce.) <br> The label may also instruct you to make a spray solution with a specific percentage of active ingredient (a.i., for example, a one percent a.i. solution for a particular pest. If the pesticide is formulated as an emulsifiable concentrate (EC) containing 57 percent active ingredient. To make a 1 percent a.i. spray solution from this formulation, you would add 1 part of the pesticide to 56 parts of water. |  |  |  |  |  |  |  |
| Glyphosate product rates based on formulation, acid equivalent (ae) and active ingredient (ai). ${ }^{2}$ | Pounds ae/gal or ai/gal are found on glyphosate product labels. The following table displays conversions. |  |  |  |  |  |  |  |
|  | Ib <br> ae | $\begin{aligned} & \text { lb } \\ & \text { ai } \end{aligned}$ | $\begin{gathered} 0.38 \\ \text { ae } \\ \hline \end{gathered}$ | $\begin{gathered} 0.57 \\ \text { ae } \\ \hline \end{gathered}$ | $\begin{gathered} 0.75 \\ \text { ae } \\ \hline \end{gathered}$ <br> fl ozlA | $\begin{gathered} 1.125 \\ \text { ae } \\ \hline \end{gathered}$ | $\begin{array}{c\|} \hline 1.5 \\ \mathrm{ae} \\ \hline \end{array}$ |  |
|  | 3 | 4 | 16 | 24 | 32 | 48 | 64 |  |
|  | 4 | 5.4 | 12 | 18 | 24 | 36 | 48 |  |
|  | 4.7 | 5.1 | 12 | 18 | 24 | 36 | 48 |  |
|  | 4.5 | 5.5 | 11 | 16 | 22 | 32 | 44 |  |
|  | 5 | 6.1 | 10 | 15 | 20 | 30 | 40 |  |

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## HAND-HELD / BACKPACK SPRAYER CALIBRATION

TABLE K - 2. BACKPACK SPRAYER CALIBRATION

| No Math Version ${ }^{3}$ |  |  |
| :---: | :---: | :---: |
| Step 1 | Establish a calibration plot that is exactly: 18.5 feet wide $\times 18.5$ feet long |  |
| Step 2 | Spray the calibration plot uniformly with water, noting the number of seconds required: | Time Required to spray plot $=\ldots$ seconds. |
| Step 3 | Spray into a bucket for same number of seconds. |  |
| Step 4 | Measure the number of ounces of water in the bucket: | Volume sprayed $=\ldots$ ounces |
| Step 5 | The number of ounces collected from the bucket is equal to the number of gallons per acre the sprayer is delivering: | Gallons Per Acre (GPA) = |
| Adding the Correct Amount of Herbicide to Tank for Liquid Herbicide Formulations |  |  |
| Step 6 | Record sprayer output in gallons/acre (calculated from Step 5). | Output (volume) $=\ldots$ GPA |
| Step 7 | Determine volume of full spray tank. | Tank volume $=\ldots$ gallons |
| Step 8 | From the herbicide label determine amount of herbicide concentrate to apply per acre. | _ Herbicide per Acre (quarts or pints) |
| Step 9 | Determine the amount of herbicide to add to each gallon using the chart below. |  |
| Step 10 | Calculate the amount of herbicide to add to each tank. | $\qquad$ Amount of herbicide/gallon x $\qquad$ number of gallons in a tank = $\qquad$ Total amount of herbicide to add to a tank. |

The following table can be used to determine the amount of pesticide, liquid or dry formulation, needed per unit area (i.e. gallons per acre or GPA) to give the rate recommended for effective control ${ }^{4}$.

TABLE K - 3. AMOUNT OF HERBICIDE TO ADD TO MEET RECOMMENDED HERBICIDE RATEIACRE BASED UPON SPRAY AMOUNT (GPA) CALIBRATED ${ }^{5}$

| Gallons / Acre (GPA) | 1 pint | 1 quart | 2 quarts | 3 quarts | 4quarts |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 15 | 6 tsp | 2 fl oz . | 4 fl oz . | 6.25 fl oz . | 8.5 fl oz . |
| 20 | 5 tsp | 10 tsp | 3.25 fl oz . | 4.75 fl oz . | 6.33 fl oz . |
| 30 | 3 tsp | 6 tsp | 2 fl oz . | 3.25 fl oz . | 4.25 fl oz . |
| 40 | 2.33 tsp | 4.75 tsp | 1.66 fl oz . | $2.33 \mathrm{fl} \mathrm{oz}$. | 3.25 fl oz . |
| 50 | 2 tsp | 3.75 tsp | 1.25 fl oz . | 2 fl oz . | 2.5 fl oz . |
| 60 | 1.66 tsp | 3.25 tsp | 6.33 tsp | 1.66 fl oz . | 2 fl oz . |
| 70 | 1.33 tsp | 2.75 tsp | 5.5 tsp | 1.33 fl oz . | 1.75 fl oz . |
| 80 | 1.25 tsp | 2.33 tsp | 4.75 tsp | 7.25 tsp | 9.5 tsp |
| 90 | 1 tsp | 2 tsp | 4.25 tsp | 6.33 tsp | 8.5 tsp |
| 100 | 1 tsp | 2 tsp | 3.75 tsp | 5.75 tsp | 7.66 tsp |
| 120 | 0.75 tsp | 1.5 tsp | 3.0 tsp | 4.75 tsp | 6 tsp |

## Liquid Conversions

3 teaspoons = 1 tablespoon
8 fl ounces $=1 \mathrm{cup}$
2 tablespoons = 1 fluid ounce
1 cup = 16 tablespoons

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Example: Assume that the calibration of your sprayer (Steps $1-5$ ) yields an output of 30 GPA and your sprayer holds 3 gallons. Your herbicide label for the target weed species indicates a herbicide application rate of 1 pint/acre. Go to the chart and read across from 30 Gal . / A to the 1-pint column - the amount of herbicide to add per gallon is 3 tsp in the chart. Since your sprayer holds 3 gallons of total solution, you would add 9 tsp of herbicide in addition to the water in each tank.

## HAND-HELD SPRAYERS ${ }^{6}$

Hand-held sprayers are often used for spot treating patches of weeds or for treating small areas such as lawns. Spray coverage should be uniform and the leaves of the target plants should be wet but the amount of spray solution applied should be limited so that run-off does not occur. Hand-held sprayers should be calibrated by 1) spraying a known area using water and a standard and reproducible procedure, 2) measuring the amount of water applied, and 3) calculating gallons per acre (gpa).

For example, 0.75 gallon on 500 sq ft is the same as 65 gallons per acre:

$$
43,560 \text { sq ft per acre } / 500 \text { sq ft } \times 0.75 \text { gallon }=65 \text { gpa. }
$$

The desired rate in $\mathrm{lb} / \mathrm{A}$ or $\mathrm{pt} / \mathrm{A}$ can be used to calculate the amount of herbicide to add to the spray solution. If $3 \mathrm{pt} / \mathrm{A}$ is desired:

$$
3 \mathrm{pt} / \mathrm{A} / 65 \mathrm{gpa}=0.046 \mathrm{pt} \text { or } 0.73 \mathrm{fl} \text { oz or } 1.5 \mathrm{Tbsp} / \mathrm{gal} \text { of spray solution ( } 16 \mathrm{fl} \mathrm{oz}=1 \mathrm{pt}, 2 \mathrm{Tbsp}=1 \mathrm{fl} \mathrm{oz} \text { ). }
$$

When calibration of a hand-held sprayer is not possible and the herbicide being used is safe to the environment and non-target plants, a volume of 50 to 70 gpa can be assumed. However, the actual volume applied can vary considerably with the type of sprayer, spray pressure, and technique of the applicator so calibration is strongly encouraged.

Some herbicide labels specify a percent solution for use in hand-held sprayers. The following chart provides mixing instructions to obtain solutions of varying percent concentrations on a volume/volume basis:

TABLE K - 4. VOLUME / VOLUME (VIV) BASIS

|  | \%Concentration of Herbicide |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Desired Solution Volume | 0.5 | 1.0 | 1.5 | 2.0 | 5.0 |
| gallons | Amount of herbicide to add, fl oz |  |  |  |  |
| 1 | 0.6 | 1.3 | 1.9 | 2.6 | 6.4 |
| 2 | 1.3 | 2.6 | 3.8 | 5.2 | 12.8 |
| 5 | 3.2 | 6.4 | 9.6 | 12.8 | 32.0 |
| 10 | 6.4 | 12.8 | 19.2 | 25.6 | 64.0 |
| 100 | 64.0 | 128.0 | 192.0 | 256.0 | 640.0 |

$1 \mathrm{pt}=16 \mathrm{fl} \mathrm{oz}$
16 Tbls = 1 cup
1 Tbls $=3 \mathrm{tsp}$
$1 \mathrm{fl} \mathrm{oz}=30 \mathrm{mls}$
1 Tbls $=15 \mathrm{ml}$
$1 \mathrm{fl} \mathrm{oz}=2$ Tbls

## ACTIVE INGREDIENT (A.I.) VERSUS ACID EQUIVALENT (A.E.)

Labels on herbicide containers and instructions for mixing herbicides sometimes use units of herbicide active ingredient (a.i.) or acid equivalent (a.e.). The herbicide may be sold in different concentrations, but units of a.i. or a.e. provide standard measures, so the mixing instructions can apply in all cases. In order to follow these instructions, you will need to determine how many a.i. or a.e. are in an ounce, or quart or liter, of the concentrate on hand.

The "active ingredient" (a.i.) of an herbicide formulation is responsible for its herbicidal activity or ability to kill or suppress plants. The a.i. is always identified on the herbicide label by either its common name or chemical name, or both. Herbicide formulations available for sale commonly contain other so-called "inert" compounds too.

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The "acid equivalent" (a.e.) of an herbicide is just the acid portion of the a.i., and it is this acid portion that is responsible for herbicidal effects. The acid portion (or parent acid) is generally associated with other chemical compounds to form a salt or an ester, which is more stable and better able to move through a plant's waxy cuticle, and into the plant. The salt or ester is the a.i.

Weak acid herbicides are formulated as salts or esters through the addition of a salt or ester molecular group to the parent acid molecule. This allows the herbicide acid to mix properly with adjuvants and enhances the compound's ability to move into plant tissue. Once the herbicide enters the plant, the salt or ester group is cleaved off the parent molecule, allowing the acid to affect the plant.

Because the salt or ester molecular group can vary dramatically in size, a measure of the percent a.i., especially in the case of a weak acid herbicide, does not adequately reflect the percentage of acid in the formulation. Thus, the a.e. is used to determine the amount of the product to be applied.

Product labels for weak acid herbicides will list the product's percentage of active ingredient, as well as other inert ingredients, at the top of the label. The percentage of acid equivalent in the formulation is usually listed below these percentages in a separate table or paragraph.

TABLE K - 5. PINTS OF COMMERCIAL PRODUCT NEEDED PER ACRE

| Pounds a.i./gallon of commercial product | Pounds of active ingredients per acre |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1/4 | 1/2 | 1 | 2 | 3 | 10 |
|  |  |  |  |  |  |  |
| 1.0 | 2 | 4 | 8 | 16 | 24 | 80 |
| 2.0 | 1 | 2 | 4 | 8 | 12 | 40 |
| 3.0 | 2/3 | $11 / 3$ | $22 / 3$ | $51 / 3$ | 8 | $262 / 3$ |
| 3.34 | 3/5 | $11 / 5$ | $22 / 5$ | 4 4/5 | $71 / 5$ | 24 |
| 4.6 | 1/2 | 1 | 2 | 4 | 6 | 20 |
| 6.0 | 1/3 | 2/3 | 1 1/3 | $22 / 3$ | 4 | $131 / 3$ |

## AQUATIC WEED CALCULATIONS

Some herbicides, such as those for control of emergent plants, are applied on the basis of the area to be treated. Others, such as those used to control certain submerged weeds, are applied on the basis of the volume of water to be treated. For aquatic weed control, the volume of water and/or area to be treated must be determined accurately. Chemical application rates are provided on the label in either an amount to apply per surface acre or per acre-foot of water. One acre is a surface area measurement of 43,560 square feet. An acre-foot is one acre of water one foot deep. To determine acre-feet of water, multiply the surface area in acres by the average depth in feet.

TABLE K - 6. SURFACE AREA CALCULATIONS

| AREA DESCRIPTION | EXAMPLES |
| :--- | :--- |
| CIRCLE $=3.14 \times$ radius $^{2}$ | EXAMPLE: a pond radius 85 feet $\times 85 \times 3.14=22686.5$ square feet total surface area $(I 43,560=1 / 2$ acre <br> surface area) |
| RECTANGLE $=$ length $\times$ width | EXAMPLE: a pond length 145 feet $\times$ width of 75 feet $=10,875$ square feet total surface area ( $I 43,560=1 / 4$ <br> acre surface area) |
| TRIANGLE $=($ base $\times$ height) $/ 2$ | EXAMPLE: a pond base of 100 feet $\times$ height of 50 feet $=5,000$ square feet $/ 2=2,500$ square feet total <br> surface area $(I 43,560=1 / 10$ acre surface area) |
| OVAL $=$ length $\times$ width $\times 0.8$ | EXAMPLE: a pond length of 200 feet $\times$ width of 90 feet $\times 0.8=14,400$ square feet total surface area ( $/ 43,560$ <br> $=1 / 3$ acre surface area) |

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## CONVERSION FACTORS

## Liquid Conversion Factors

1 gallon $=4$ quarts or 8 pints or 3,785 cc or 128 fluid ounces
1 quart $=2$ pints or 4 cups or 946 cc or 32 fluid ounces
1 pint $\quad=2$ cups or 473 cc or 16 fluid ounces
1 cup $=16$ tablespoons or 236.5 cc or 8 fluid ounces
1 tablespoon $=3$ teaspoons or 15 cc or 0.5 fluid ounces
2 tablespoons = 1 fluid ounce

## Weight Conversion Factors

1 pound $=16$ ounces or 454 grams
1 ounce $=28.4$ grams or 30 cc
Plot Size Factors

| 1 rod | $=16.5$ feet |
| :--- | :--- |
| 1 square rod | $=16.5 \times 16.5$ feet or 272 square feet |
| 1 acre | $=160$ square rods |
| 1 acre | $=43,560$ square feet |

## Application Factors

1 cup per square rod $=10$ gallons per acre
1 pint per square rod $\quad=20$ gallons per acre
1 quart per square rod $=40$ gallons per acre
1 gallon per square rod $=160$ gallons per acre

TABLE K-7. METRIC CONVERSIONS ${ }^{7}$

| Symbol | When you know | Multiply by | To Find | Symbol |
| :---: | :--- | :---: | :--- | :---: |
| lb | pounds | 0.45 | kilograms | kg |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.95 | liters | l |
| oz | ounces | 30.0 | milliliters | ml |
| A | acres | 0.4 | hectares | ha |
| ha | hectares | 2.5 | acres | A |

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TABLE K - 8. COMMON UNIT CONVERSIONS AND ABBREVIATIONS

| Multiply... | By... | To Get... |
| :---: | :---: | :---: |
| Acres | 0.4047 | Hectares (ha) |
| Acres | 4047 | Square Meters (m2) |
| Acres | 4840 | Square Yards |
| Acres | 43,560 | Square Feet |
| Cubic Feet | 1728 | Cubic Inches |
| Cubic Feet | 0.037 | Cubic Yards |
| Cubic Feet | 7.481 | Gallons |
| Cubic Feet | 59.84 | Pints |
| Cubic Feet | 29.92 | Quarts |
| Cups | 8 | Ounces |
| Cups | 16 | Tablespoons |
| Cups | 48 | Teaspoons |
| Gallons | 3.785 | Liters (L) |
| Gallons | 128 | Ounces |
| Gallons | 8 | Pints |
| Gallons | 4 | Quarts |
| Gallons per Acre (gal/acre) | 9.34 | Liters per Hectare (L/ha) |
| Grams (g) | 0.001 | Kilograms |
| Grams (g) | 1000 | Milligrams |
| Grams (g) | 0.035 | Ounces (oz) |
| Grams per Liter (g) | 1000 | Parts per Million |
| Hectares (ha) | 2.47 | Acres |
| Inches (in) | 2.54 | Centimeters (cm) |
| Kilograms (kg) | 1000 | Grams (g) |
| Kilograms (kg) | 35.274 | Ounces (oz) |
| Kilograms (kg) | 2.2046 | Pounds (lb) |
| Kilograms per hectare (kg/ha) | 0.892 | Pounds per Acre (lb/acre) |
| Kilometers (km) | 0.6214 | Miles (mi) |
| Liters (L) | 1000 | Cubic Centimeters (cm3) |
| Liters (L) | 0.2642 | Gallons (gal) |
| Liters (L) | 33.814 | Fluid Ounces (oz) |
| Meters (m) | 100 | Centimeters |
| Meters (m) | 3.281 | Feet |
| Meters (m) | 0.001 | Kilometers |
| Meters (m) | 39.37 | Inches |
| Meters (m) | 1.094 | Yards |
| Miles (mi) | 1.609 | Kilometers (km) |
| Miles (mi) | 5280 | Feet |
| Miles (mi) | 1760 | Yards |
| Miles per Hour (mi/hr) | 44.70 | Centimeters per Second (cm/sec) |
| Miles per Hour (mi/hr) | 88 | Feet per Minute |
| Miles per Hour (mi/hr) | 1.467 | Feet per Second |
| Miles per Minute | 88 | Feet per Second |
| Miles per Minute | 60 | Miles per Hour |
| Milligrams (mg) | 0.000035 | Ounces (oz) |
| Milliliters (ml) | 0.0338 | Ounces (oz) |
| Ounces (oz) - dry | 0.063 | Pounds |
| Ounces (oz) - liquid | 0.063 | Pints |
| Ounces (oz) - liquid | 0.031 | Quarts |
| Ounces (oz) - liquid | 480 | Drops |
| Ounces (oz) - liquid | 29.573 | Milliliters (ml) |
| Ounces (oz) - liquid | 0.02957 | Liters |
| Ounces (oz) - liquid | 29.5735 | cubic centimeters (cm3) |
| Ounces (oz) | 2 | Tablespoons |
| Ounces (oz) | 6 | Teaspoons |
| Ounces (oz) | 28.3495 | Grams (g) |
| Ounces per acre (oz/acre) | 70.1 | Grams per Hectare (g/ha) |
| Ounces per Acre (oz/acre) | 0.0701 | Kilograms per Hectare (kg/ha) |
| Parts per Million | 0.001 | Grams per Liter |
| Parts per Million | 0.05842 | Grains per Gallon |
| Parts per Million | 1 | Milligrams per Liter |
| Parts per Million | 0.0001 | Percent |
| Parts per Million | 1 | Milligram per Kilogram |
| Pints | 0.125 | Gallons |
| Pints | 0.473 | Liters |
| Pints | 2 | Cups |

## APPENDIX K <br> CALIBRATIONS, CALCULATIONS, \& CONVERSIONS

| Multiply... By... |  |  |
| :--- | :--- | :--- |
| Pints - liquid | 16 | Ounces - liquid |
| Pints - liquid | 0.5 | Quarts - liquid |
| Pounds (lb) | 16 | Ounces |
| Pounds (lb) | 0.01 | Hundredweight (CWT) |
| Pounds (lb) | 453.6 | Grams (g) |
| Pounds (lb) | 0.4536 | Kilograms (kg) |
| Pounds per acre (lb/acre) | 1.121 | Kilograms per hectare (kg/ha) |
| Pounds per acre (lb/acre) | 112.1 | mg/square meter (mg/m2) |
| Pounds per acre (lb/acre) | 11.21 | $\mu \mathrm{~g} / \mathrm{square} \mathrm{centimeter} \mathrm{( } \mathrm{\mu g} / \mathrm{cm} 2)$ |
| Pounds per gallon (lb/gal) | 119.8 | grams per liter (g/L) |
| Pounds per gallon (lb/gal) | 7.48052 | Pounds per Cu. Foot |
| Quarts | 2 | Pints |
| Quarts | 0.25 | Gallons |
| Quarts | 0.946 | Liters |
| Quarts - liquid | 32 | Ounces - liquid |
| Quarts - liquid | 2 | Pints - liquid |
| Square centimeters (cm2) | 0.155 | Square inches (in2) |
| Square centimeters (cm2) | 0.0001 | Square meters (m2) |
| Square meters (m2) | 10,000 | Square centimeters (cm2) |
| Tablespoons | 3 | Teaspoons |
| Tablespoons | 0.5 | Ounces - liquid |
| Teaspoons | 60 | Drops |
| Teaspoons | 0.33 | Tablespoons |
| Teaspoons | 0.1666 | Ounces - liquid |
| Tons | 907.185 | Kilograms |
| Yards | 0.9144 | Meters |
| Note: All references to pounds |  |  |

Note: All references to pounds and ounces refer to English units of measurement unless otherwise specified.
TABLE K - 9. BAND WIDTH (FT) DISTANCE REQUIRED TO TREAT ONE ACRE

| Band width (ft) | Feet | Miles |
| :---: | ---: | ---: |
| 1 | 43,560 | 8.25 |
| 2 | 21,780 | 4.13 |
| 3 | 14,520 | 2.75 |
| 4 | 10,890 | 2.06 |
| 5 | 8,712 | 1.65 |
| 10 | 4,356 | 0.8 |

# APPENDIX K <br> CALIBRATIONS, CALCULATIONS, \& CONVERSIONS 

[^5]
[^0]:    ${ }^{1}$ Montana State University Extension Service, 2000. MontGuide MT 2000-14

[^1]:    ${ }^{2}$ NDSU 2005

[^2]:    ${ }^{3}$ Montana State University Extension Service, 2000. MontGuide MT 2000-14
    ${ }^{4}$ Source: Bussan, et al, 2001-2002
    ${ }^{5}$ tsp = teaspoons
    TBS = tablespoons
    fl oz. = fluid ounces

[^3]:    ${ }^{6}$ NDSU 2005.

[^4]:    ${ }^{7}$ Conversions in this metric guide are pounds per acre to kilograms per hectare
    Example: $2 \mathrm{lb} / \mathrm{A}$ to $\mathrm{kg} / \mathrm{ha}=2 \times 0.45=0.90 \mathrm{~kg} / \mathrm{A} \times 2.5=2.25 \mathrm{~kg} / \mathrm{ha}$

[^5]:    - End of Appendix K -

