

# Miscellaneous

## Flag the Technology Marker Flag Colors

### Color Codes

#### RED

signifies conventional varieties with no herbicide technology traits. *Extreme caution.*



#### BRIGHT YELLOW

is the color chosen for Clearfield® rice technology and STS® soybeans.<sup>1</sup>



#### WHITE

represents the Roundup Ready® technology that is tolerant to glyphosate herbicide.



#### TEAL

indicates tolerance to both 2,4-D and FOP (Acuse) herbicides or the Enlist® technology. The white stripes indicate tolerance to glyphosate. For Enlist cotton and soybean fields, a green flag should be added to denote tolerance to glufosinate (Liberty).



#### BRIGHT GREEN

indicates the Liberty Link® technology. This technology is tolerant to glufosinate (Liberty®) herbicide.



#### BLACK

indicates tolerance to dicamba herbicide or Xtend®. The black and white checks indicate tolerance to both dicamba and glyphosate (Roundup). A green flag should be added for cotton to denote glufosinate (Liberty) tolerance.



<sup>1</sup>Although many herbicides are in the ALS family of herbicides, crops with this technology are not tolerant to all ALS herbicides.



# Chemical Formulation Abbreviations\*

Abbreviation	Meaning
AF	Aqueous flowable
AS	Aqueous solution or suspension
C	Concentrate
CM	Concentrate mixture
CG	Concentrate granules
D	Dust
DF	Dry flowable
DS	Soluble dust
E or EC	Emulsifiable concentrate
F	Flowable (liquid)
G	Granules
GL	Gel
L	Liquid (flowable)
LC	Liquid concentrate or low concentrate
LV	Low volatile
M	Microencapsulated
MTF	Multiple temperature formulation
P or PS	Pellets
RTU	Ready-to-use
S	Solution
SD	Soluble dust
SG	Soluble granule
SP	Soluble powder or soluble packet
ULV	Ultra low volume
ULW	Ultra low weight or ultra-low wettable
W	Wettable powder
WDG	Water-dispersible granules
WP	Wettable powder
WS	Water soluble
WSG	Water-soluble granules
WSL	Water-soluble liquid
WSP	Water-soluble powder packet

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*\*Common abbreviations encountered in rice production; may include some that do/do not apply.*

# Spray Tip Classification by Droplet Size

Classification Category	Color Code	Droplet Size	Approximate VMD ( $\mu\text{m}$ ) <sup>†</sup>	Coverage	Used For	Drift Potential
Extremely Fine	Purple	Small	< 50	Excellent	Exceptions	High
Very Fine	Red		51-150	Excellent	Exceptions	
Fine	Orange		151-230	Very Good	Good Cover	
Medium	Yellow		231-340	Good	Most Products	
Coarse	Blue		341-405	Moderate	Systemic Herbicides	
Very Coarse	Green		405-505	Poor	Soil Herbicides	
Extremely Coarse	White		506-665	Very Poor	Liquid Fertilizer	
Ultra Coarse	Black		Large	> 665	Very Poor	

<sup>†</sup>Estimated from sample reference graph in ASABE/ASAE Standard S572.1 2009. Spray Nozzle Classification by Droplet Spectra. American Society of Agricultural and Biological Engineers.

## Relative Sensitivity<sup>1</sup> of Major Arkansas Field Crops to Commonly Used Rice Herbicides

Herbicide Trade Name (common name)	Soybean	Corn	Cotton	Milo	Rice
Numerous (glyphosate)	T*	T*/VS	T*/S	VS	VS
Newpath (imazethapyr)	T	S	S	S	T*/VS
Facet (quinclorac)	M	M	S	T	T
Prowl (pendimethalin)	T	T	T	M	T
Command (clomazone)	T	M	M	M	T
Numerous (propanil)	S	S	S	S	T
Regiment (bispyribac)	M*/VS	S	S	S	T
Permit (halosulfuron)	T*/VS	T	S	T	T
Grasp (penoxsulam)	M*/VS	S	S	S	T
Londax (bensulfuron-methyl)	M*/VS	S	S	S	T
Strada (orthosulfamuron)	M*/VS	S	S	S	T
Ricestar (fenoxaprop)	T	VS	T	VS	T
Clincher (cyhalofop)	T	VS	T	VS	T
Blazer/Storm (acifluorfen)	T	M/S	M	M/S	T
Numerous (2,4-D)	S	T	VS	T	T
Grandstand (triclopyr)	S	M	S	M	T
Aim (carfentrazone)	M	M/S	M/S	M/S	T

<sup>1</sup>T = Tolerant, M = Moderately Tolerant, S = Sensitive, VS = Very Sensitive

T\*/M\* = Some crops are available with tolerance/moderate tolerance to these herbicides.

\*\*Read and follow all label directions when using these products.\*\*

# Grades and Grade Requirements

Grade	Maximum limits of ----									
	Seeds and heat-damaged kernels				Red rice and damaged kernels	Chalky kernels			Color requirements	
	Total	Heat-damaged and other	Heat-damaged kernels	Long grain rice		Medium or short grain rice	Other types <sup>†</sup>			
	# <sup>1</sup>	#	#	% <sup>2</sup>	%	%	%			
U.S. #1	4	3	1	0.5	1.0	2.0	1.0	White/creamy		
U.S. #2	7	5	2	1.5	2.0	4.0	2.0	Slightly gray		
U.S. #3	10	8	5	2.5	4.0	6.0	3.0	Light gray		
U.S. #4	27	22	15	4.0	6.0	8.0	5.0	Gray/rosy		
U.S. #5	37	32	25	6.0	10.0	10.0	10.0	Dark gray/rosy		
U.S. #6	75	75	75	15.0	15.0	15.0	10.0	Dark gray/rosy		

<sup>1</sup># = Number per 500 grams of seed.

<sup>2</sup>% = Percent of kernels.

U.S. Sample grade shall be rough rice which:

- does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 6 inclusive;
- contains more than 14.0 percent of moisture;
- is musty, or sour, or heating;
- has any commercially objectionable foreign odor; or
- is otherwise of distinctly low quality.

## Grades and Grade Requirements for the Classes of Long-Grain Milled rice, Medium-Grain Milled Rice, Short-Grain Milled Rice, and Mixed Milled Rice, USDA, 2009

Grade	Maximum limits of ----										Color requirements	Minimum milling requirements
	Seeds, damaged and paddy kernels		Red rice and damaged kernels	Chalky kernels		Broken kernels			Other types†			
				Long grain rice	Medium or short grain rice	Total	Removed by 5 plate†	Removed by 6 plate†	Whole kernels	Whole and broken kernels		
#1	#	%2	%	%	%	%	%	%	%	%		
U.S. #1	2	1	0.5	1.0	2.0	4.0	0.04	0.1	--	1.0	White, creamy	Well milled
U.S. #2	4	2	1.5	2.0	4.0	7.0	0.06	0.2	--	2.0	Slightly gray	Well milled
U.S. #3	7	5	2.5	4.0	6.0	15.0	0.1	0.8	--	3.0	Light gray	Reasonably well milled

U.S. #4	20	15	4.0	6.0	8.0	25.0	0.4	1.0	--	5.0	Gray, rosy	Reason- ably well milled
U.S. #5	30	25	6.0	10.0	10.0	35.0	0.7	3.0	10.0	---	Dark gray, rosy	Reason- ably well milled
U.S. #6	75	75	15.0 <sup>††</sup>	15.0	15.0	50.0	1.0	4.0	10.0	---	Dark gray, rosy	Reason- ably well milled

<sup>1</sup># = Number per 500 grams of seed.

<sup>2</sup>% = Percent of kernels.

U.S. Sample grade shall be milled rice of any of these classes which:

- does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 6, inclusive;
- contains more than 15.0 percent of moisture;
- is musty or sour, or heating;
- has any commercially objectionable foreign odor;
- contains more than 0.1 percent of foreign material;
- contains two or more live or dead weevils or other insects, insect webbing, or insect refuse; or
- is otherwise of distinctly low quality.

## Example of Foreign Material and Low Milling Yield Effects on Rice Price and Net Profit

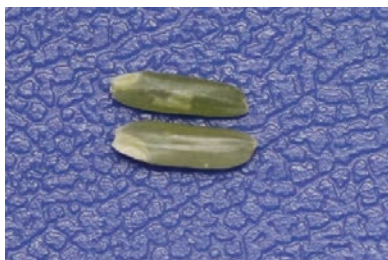
Description	Sample 1	Sample 2	Sample 3
Sample weight, grams	162	162	162
Foreign material, grams	0	0	10
Head rice weight, grams	89	94	88
Broken weight, grams	24	19	18
Milling yield percentage	55/70	58/70	54/65
Value per hundredweight <sup>1</sup>	\$6.48	\$6.60	\$6.13
<hr/>			
Difference in price/cwt	--	+\$0.12	-\$0.35
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Value at 150 bu/A	\$437.84	\$445.95	\$414.19
Value difference at 150 bu/a	--	+\$8.11	-\$23.65
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Value at 200 bu/A	\$583.78	\$594.59	\$552.25
Value difference at 200 bu/a	--	+\$10.81	-\$42.34



## Production Factors Impacting Rice Milling Yield



*Chalk affecting a region of a kernel (left) or the entire kernel (right).*



*Immature kernels after harvest and hulling.*



*Kernel fissured due to rapid moisture adsorption.*

## Glossary of Rice Industry Terms

**Aging** – physiological changes rice undergoes predominately during the initial three postharvest months.

**Amylopectin** – one of two major starch molecules characterized by glucose units arranged in a linear, unbranched chain. Higher concentrations contribute to drier, less sticky cooked rice.

**Anthesis** – the series of events between opening and closing of the rice flower (spikelet). Also referred to as **Flowering**.

**Aromatic (scented) Rice** – rice that contains high concentrations of volatile constituents yielding an aroma similar to roasted popcorn or nuts.

**Auricles** – clasping appendages arising at the junction of the leaf blade and the leaf sheath.

**Basmati Rice** – a type of aromatic rice that tends to cook into long, slender grains that are dry, separate and fluffy.

**Barrel** – unit of measure of rough rice used in some areas of the U.S.; equivalent to 162 pounds of rough rice (3.6 bushels).

**Booting** – stage prior to heading characterized by swelling of the leaf sheath as the panicle grows in size and internodes elongate, pushing it up through the leaf sheath. During this stage, meiosis occurs and pollen is formed. One of the stages most vulnerable to environmental stresses.

- Bran** – outer layers or coverings of brown rice; composed of the pericarp, seed coat and aleurone layer. (**Note:** industrial bran normally is a mixture of bran and embryo).
- Breeder Seed** – seed reserved for licensed plant breeders for production of foundation, registered or certified seed; marked with a white tag.
- Brewers Rice** – small pieces of broken rice kernels.
- Brown (cargo) Rice** – the rice kernel with the protective hull removed.
- Bushel** – volumetric measure of rough rice approximately equivalent to 45 pounds.
- Caryopsis** – the mature fruit of grasses in which the seed coat firmly adheres to the pericarp.
- Certified Seed** – produced by planting either registered or foundation seed and guaranteed for purity by the State Plant Board; marked with a blue tag.
- Chalky Rice** – rice that has a brittle texture due to loose packing of starch granules in the grain; results in weaker grain more susceptible to breaking.
- Coleoptile** – the topmost part of the embryo axis that serves as a protective sheath for young leaves and the growing point during seedling emergence.
- Converted Rice** – (see **Parboiled Rice**). The term “converted rice” is a trademark.

**Crown** – the compacted section at the base of the stem containing nodes for new tillers and buds for new roots.

**Culm** – a commonly used name for the stem of a grass-type plant, such as rice, consisting of nodes and hollow internodes.

**Cultivar** – an inclusive term that represents lines, hybrids, selections or varieties of crops. (see also **Hybrid, Variety**)

**Embryo (germ)** – the reproductive portion of the rice grain located on the ventral side.

**Endosperm** – the white central portion of the rice grain, composed primarily of starch.

**Enrichment** – the addition of specific nutrients to partially compensate for those lost during the milling process. Regulations in the U.S. specifically stipulate enrichment for rice must contain thiamine, niacin and iron and may contain riboflavin.

**Flag Leaf** – the last leaf to develop on a tiller that emerges during boot stage and fully extends in full boot stage. Major source for carbohydrates and nutrients for the developing panicle.

**Flowering** – (see **Anthesis**)

**Fortification, Glazing** – (see **Enrichment**)

**Foundation Seed** – produced by planting breeder seed. Is reserved for licensed plant breeders but may be produced under direct supervision of a licensed plant breeder to maintain genetic purity and identity of the cultivar. Used to produce registered or certified seed; marked with a white tag.

**Gelatinization Temperature** – the temperature at which irreversible swelling of the starch grains leads to formation of a gel (induced by hot water).

**Genetically Modified Organism (GMO)** – a plant or animal that has a gene inserted from another organism resulting in the expression of a desirable trait.

**Green Ring** – (see **Panicle Initiation**)

**Hard Dough Stage** – part of the process of grain ripening characterized by a firm whole kernel but moisture content greater than 20 percent.

**Heading** – growth stage when the panicle exserts from the boot, often synonymous with anthesis or flowering of the spikelets. Heading date is defined as the time when 50% of the panicles have at least partially exserted from the boot. It takes 10 to 14 days for a field to complete heading.

**Head Rice** – after milling, unbroken kernels of rice and broken kernels that are at least three-fourths the length of an unbroken kernel. Usually expressed as a percentage of rough rice (referred to as head rice yield [HRY]).

**Heat-Damaged Grains** – kernels of rice reddish-brown to orange in color and are substantially darker than the majority of the grain. This defect may occur in white or parboiled rice.

**Hull** – outer covering structures (palea and lemma) that enclose the rice kernel.

**Husk** – (see **Hull**)

**Hundredweight (cwt)** – a mass measurement of rice yield equal to 100 pounds of rough rice (2.22 bushels).

**Hybrid** – the first-generation (F1) progeny of a cross between two plants of the same species but have different genetic backgrounds (e.g., different varieties or lines).

**Imbibition** – initial process of seed germination characterized by water absorption into the seed.

**Indica Rice** – subspecies of rice that typically is long-grain, has high amylose content, profuse tillering, high pubescence (hairy leaves); typically grown in tropical climates; tends to cook dry, loose and fluffy.

**Instant Rice** – a type of precooked rice that is easily rehydrated at temperatures below boiling. Typically it is fully hydrated in less than 5 minutes when added to boiling water.

**Internode Elongation (IE)** – the period when internodes elongate and the plant grows in height. Begins at panicle initiation (PI) and continues until the plant reaches full height. Often called “jointing.”

**Japonica Rice, Temperate** – subspecies of rice characterized as long-grain rice with intermediate amylose content (20% to 25%), low tillering, smooth leaves (not hairy); typical of most U.S. long-grain varieties.

**Japonica Rice, Tropical** – subspecies of rice characterized as medium- and short-grain rice with low amylose content (10% to 20%) which causes it to cook wet and sticky; typical of most U.S. medium- and short-grain varieties.

**Jasmine Rice** – an aromatic long-grain rice that cooks moist and often clings together.

**Lemma** – the part of the rice hull which covers two-thirds of the surface area of brown rice.

**Length, Kernel** – the distance between the most distant tips of the kernel.

**Ligule** – a membranous fringe on the inner side of the leaf at the top of the leaf sheath of rice and other grass plants.

**Maximum Tillering** – the point at which the maximum tiller number is reached and the main culm is difficult to distinguish from the tillers.

**Meiosis** – the process of cell production that reduces the chromosome number in new cells by one-half the number in the parent cells (reduction division). Sex cells are formed by meiosis.

**Mesocotyl** – the internode between the scutellar node and the coleoptile.

**Milk Stage** – the first step in the grain-ripening process characterized by developing starch grains in the kernel that are soft and the interior of the kernel is filled with white liquid resembling milk.

**Mill, Rice** – a machine for removing bran from the endosperm. Mills are of two general types: *polishers* that rub the bran off (friction-type mill or pearlier) and *whiteners* that grind or strip the bran away.

**Milled Rice** – whole or broken kernels of raw or parboiled rice from which hulls, bran and germ have been removed. Usually expressed as a percentage of rough rice.

**Milling, Degree of** – the extent to which bran layers and germ are removed from the rice endosperm.

**Milling Yield** – after milling, the quantity of total milled rice produced in the milling of rough rice to a well-milled degree (includes all kernels whole and broken), usually expressed as a percent of rough rice (total milling yield [TMY]), but when specified may be expressed a percent of brown rice.

**Palea** – part of the rice hull which covers approximately one-third of the surface area of brown rice. Its edges fit inside those of the lemma forming a tight closure.

**Panicle Differentiation (PD)** – when the young panicle has grown about 1 to 2 mm long and can be seen by the naked eye. Generally occurs about 5 to 7 days after panicle initiation when the internode is 1/2 to 3/4 inch in length.

**Panicle Initiation (PI) or Panicle Primordia Initiation** – corresponds to the time when the fourth leaf from the top begins to elongate, approximately 30 days before heading. The panicle is not visible to the naked eye. Often called **Green Ring** or *beginning internode elongation*.

**Parboiled Rice** – rice that has undergone a parboiling process.



**Parboiling (converting)** – a hydrothermal process in which the crystalline form of starch is changed into an amorphous one, typically accomplished by soaking, steaming and drying rough rice; typically increases the percentage of head rice and the vitamin content in the milled rice.

**Pecky Rice** – discoloration of rice grain due to rice stink bug feeding, environment, diseases and other factors; generally results in easily broken kernels.

**Physiological Maturity** – the end of the grain filling period, at which time growth increases are in balance with metabolic losses.

**Polishing** – the removal of traces of bran that remain after milling; resulting in a smooth surface that has a glossy appearance (see **Milled Rice**).

**Quality, Rice** – the composite of characteristics that differentiate individual units of rice and have significance in determining the degree of acceptability by the consumer. Rice quality components include milling quality; cooking, eating and processing quality; nutritional value; and specific standards for cleanliness and purity.

**Quick-Cooking Rice** – rice that has been pretreated to substantially reduce cooking time, especially rice that has been cooked in water, steam or both, then dried in such a manner as to retain an open, porous structure without clumping.

**Red Rice** – rice of the same genus and species as white rice but characterized by a red seed coat. The hull may be black or straw-colored. Noxious weed because of discoloration of white rice.

**Registered Seed** – used to produce certified seed. Produced by planting breeder or foundation seed; marked with a purple tag.

**Rough (paddy) Rice** – whole or broken unhulled kernels of rice.

**Shell** – (see **Hull**)

**Stabilized Rice Bran** – rice bran that has been treated to essentially inactivate or inhibit enzymes that hydrolyze lipids to release free fatty acids.

**Soft Dough Stage** – part of the grain-ripening process characterized by the initial starch formation in the grain. The interior of the kernel is firm but still soft.

**Tillering** – production of tillers which are shoots that develop from the leaf axils at each un-elongated node of the main shoot and from other tillers. Tillers are produced in a synchronous manner, the  $n$ th leaf on the main culm (or tiller which is producing tillers) and the first leaf of the tiller on the  $(n+3)$ th leaf emerge simultaneously.

**Variety** – a genetically pure line of a crop species that exhibits certain traits; seed will produce plants that exhibit the same traits as the original plant. An experimental line becomes a variety when it is officially named and released for commercial production.

**Vegetative Lag Phase** – the period from the end of active tillering (maximum tiller number) to the beginning of the reproductive stage which occurs upon initiation of the panicle primordial.

**Waxy Rice** – rice whose starch contains less than 2 percent amylose.

**Width, Kernel** – the distance across the kernel at the widest point.

**Y-Leaf** – “young leaf”; youngest fully developed leaf on the plant.

## Calibration

GPM = gallons per minute

GPA = gallons per acre

mph = miles per hour

W = nozzle spacing (in.) - broadcast spray  
= spray width (in.) – single nozzle – band or boomless spray  
= row spacing (in.) divided by nozzles per row for directed spray

Formulas:

$$\text{GPM (per nozzle)} = \frac{\text{GPA} \times \text{mph} \times W}{5,940}$$

$$\text{GPA} = \frac{5,940 \times \text{GPM (per nozzle)}}{\text{mph} \times W}$$

### Measuring Travel Speed

Measure a test course with similar surface conditions to area to be sprayed. Minimum travel length of 100 and 200 ft recommended for speeds up to 5 and 10 mph, respectively.

$$\text{Speed (mph)} = \frac{\text{Distance (ft)} \times 60}{\text{Time (seconds)} \times 88}$$

Ounce Method for determining GPA

$$\text{Calibration distance (feet)} = \frac{4,080}{\text{average row or nozzle spacing (inches)}}$$

Determine time required to travel calibration distance. Catch nozzle discharge for the same length of time required to travel calibration distance. Number of ounces collected is equal to GPA applied.

## Abbreviations

<b>Area</b>		
acre (ac or A)	hectare (ha)	square foot (ft <sup>2</sup> )
<b>Measure</b>		
foot/feet (ft)	inch (in)	yard (yd)
centimeter (cm)	meter (m)	kilometer (km)
<b>Volume</b>		
gallon (gal)	fluid ounce (fl oz)	pint (pt)
quart (qt)	liter (L)	milliliter (mL)
<b>Weight</b>		
pound (lb)	ounce (oz)	kilogram (kg)
gram (g)	milligram (mg)	microgram (μg)
<b>Speed</b>		
mile per hour (mph)	kilometer per hour (kmh)	feet per second (ft/s)
<b>Yield</b>		
pounds per acre (lb/A)	kilogram per hectare (kg/ha)	bushels per acre (bu/A)
bushels per hectare (bu/ha)	bushel (bu)	
<b>Pressure</b>		
pounds per square inch (PSI)		

# Conversion Factors

## Mass

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1 g	=	0.0022 lb
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454 g	=	1 lb
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1 kg	=	2.2 lb
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## Length

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1 m	=	3.283 ft
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2.54 cm	=	1 in
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1 yd (yard)	=	3 ft
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## Volume

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1 L	=	0.265 gal
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3.785 L	=	1 gal
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1 gal	=	4 qt/8 pt/128 fl oz
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## Area

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1 ha (hectare)	=	2.471 A
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0.405 ha	=	1 A
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1 A	=	43,560 ft <sup>2</sup>
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## Application Rate or Crop Yield

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1 kg/ha	=	0.893 lb/A
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1 bu/ha	=	0.405 bu/A
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1 bu/A	=	45 lb
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3.6 bu/A	=	1 barrel
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## Concentration

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g/L	=	parts per thousand
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mg/L	=	parts per million
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mg/kg	=	parts per million
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### **Application Rate**

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1 gal/A = 9.35 L/ha

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1 lb/A = 1.12 kg/ha

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mg/kg = parts per million

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### **Speed**

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1 mph = 1.609 kmh

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### **Pressure**

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1 PSI = 0.069 bar/6,896 kilopascal

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# Contacts

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