

Module

7

After you have completed this module, you will be able to:

- *Select the correct equipment to apply pesticides in a safe manner*
- *Minimize off-target applications*
- *Calculate the correct pesticide dose*
- *Complete essential maintenance calibrations.*

Pesticide Application

It is very important to apply pesticides correctly to ensure your personal safety, obtain the best efficacy, protect the environment and avoid pesticide residues in the food you produce.

Initial Critical Stages of Pesticide Application

- Correctly identify the pest (problem) and ensure that treatment is required
- Select the safest and most appropriate product for the job
- Handle the product safely during transportation and storage
- Have all necessary safety and cleanup equipment on hand
- Read and ensure you understand the label
- Know your crop is at the correct stage of treatment
- Ensure that you have the right application equipment and that it is in good working order
- Be prepared to deal with any problem or emergency.

The next step is to mix and apply the chemical using the proper equipment and correct techniques.

Most pesticides are applied as sprays or granules, but many other applications are also useful. For example, livestock insecticides may be wiped on animals as they pass through a gate.

How to Select Spraying Equipment

Application equipment is the key component in the transfer of the active ingredient from the product to the final target. This transfer may include:

- Spray droplet formulation (for liquids)
- Transport to the target
- Contact by the target
- Distribution and retention on the target.

Choose application equipment that applies the pesticide uniformly to the desired pest at the correct rate and does not contaminate non-target sites. The equipment must have the proper components and be operated correctly,

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calibrated correctly, maintained and designed to minimize applicator exposure during loading and application.

A variety of application equipment is available for applying pesticides. Know the types and characteristics of available equipment and the details of the application (e.g., pest, site) to help you choose suitable equipment. Table 1 Field-Scale Equipment describes the features and use of some of the equipment available.

Table 1. Field-Scale Equipment

Equipment	Features	Uses
1.. Trailer-mounted Field Sprayers	<ul style="list-style-type: none"> •Available in various sizes of tanks and booms •Inexpensive relative to size •Parts readily available •Can be pulled with existing equipment 	<ul style="list-style-type: none"> •Field spraying of all solid seeded crops
2. Truck-mounted Sprayers	<ul style="list-style-type: none"> •Unstable booms cause uneven spray patterns •Difficult to maintain constant ground speed •Handy and mobile 	<ul style="list-style-type: none"> •Pasture spraying •Where there are long distances between fields or spot treatments •Field spraying especially for insects
3. Self-Propelled Sprayers (available in high-volume floaters, low-volume spray coupes, medium/high-volume 4-wheel drive and floaters)	<ul style="list-style-type: none"> •Versatile •Expensive •Fast and accurate •Less of a footprint than pull types 	<ul style="list-style-type: none"> •Very large farms •Custom operations •Almost all field spraying
4. Aerosol Generators and Foggers (blast sprayers)	<ul style="list-style-type: none"> •Converts special formulations into fine droplets (aerosols) •Specialized uses 	<ul style="list-style-type: none"> •Nurseries, greenhouses, barns •Orchards •For mosquitoes in outdoor recreation areas •Outdoor use is limited because of potential for drift from target area
5. Dual Cloud Electrostatic Sprayer	<ul style="list-style-type: none"> •Expensive •Very light •Portable •Truck mounted •No mixing of chemical and water •Sprays water and insecticide separately •Very small amount of chemical required—extremely low volume 	<ul style="list-style-type: none"> •Spray cattle in pasture—no need to round them up •Control black flies and mosquitoes

Table 2 Small-Scale Application Equipment describes the features and uses of some of the small-scale equipment available. In general, small-scale equipment allows you to treat a small area at a time and avoid off-target

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contamination and is used for small areas where large equipment cannot maneuver.

Table 2. Small-Scale Application Equipment

	Equipment	Features	Uses
1.	All-Terrain Vehicles (ATV) or Three Point Hitch Sprayers	<ul style="list-style-type: none"> •Equipped with short boom and handgun •Can go almost anywhere; are safer and have much more capacity than backpack equipment •Expensive unless you already have the ATV or small tractor 	<ul style="list-style-type: none"> •Used for small areas not accessible by a larger sprayer •Good for spot spraying weed patches in fields or weed control around farmyards •Useful in rough land and pastures to control patches of perennials or poisonous weeds
2.	Backpack sprayers	<ul style="list-style-type: none"> •Plastic units are lightweight and the liquid level is visible, allowing you to better judge volume applied •Exceptionally hazardous to the applicator if there are leaks or if chemical has spilled during filling 	<ul style="list-style-type: none"> •Used for spot spraying or very small areas around the farmstead, shelterbelts and other areas not accessible by larger equipment
3.	Hand-held Sprayers	<ul style="list-style-type: none"> •Safer but less convenient than backpack •Holds smaller volumes than a backpack sprayer •Inexpensive 	<ul style="list-style-type: none"> •Used for spot spraying or very small areas around farmstead, shelterbelts and other areas not accessible by larger equipment
4.	Wick Applicators	<ul style="list-style-type: none"> •Selectively apply herbicide by wiping it on plants •Very low capacity 	<ul style="list-style-type: none"> •Useful when selective weed control is required and no drift can be tolerated •Used in row crops or in pastures or fields where weeds are higher than crops
5.	Cattle Back Rubbers	<ul style="list-style-type: none"> •Horizontal or vertical tubes of plastic or metal equipped with fabric skirt or wicks with metal chain 	<ul style="list-style-type: none"> •Used as self-treatment devices at entrance to milk room, water trough and fenced dugout. Also free choice use at the entrance of specially fenced salt lick stations

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Sprayer Components

Application equipment is made of different components that work together to apply the pesticide.

All sprayers consist of basic components that perform standard functions:

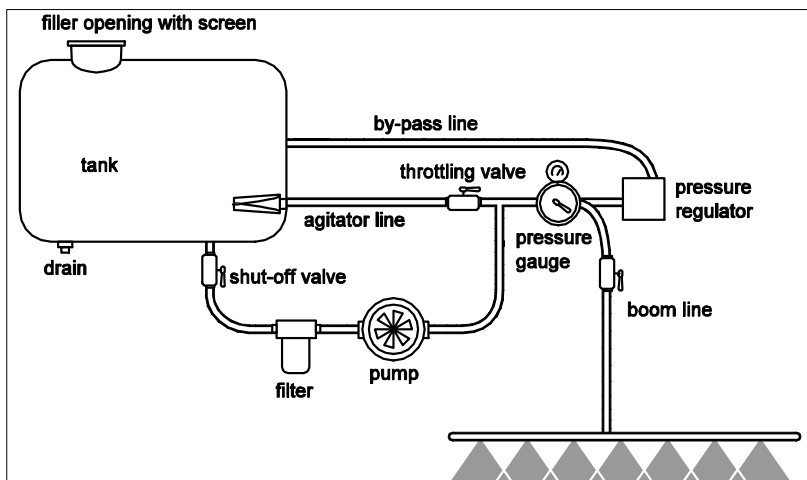
- Tank(s) hold and carry chemical solutions
- Pumps, pressure controls, agitators and filters meter the correct quantity of pesticide, control pressure and volume and prevent plugging
- Booms and nozzles distribute the material accurately in a uniform pattern.

Reduce Personal and Environmental Risks of Sprayers

- Understand sprayer components and ensure yours are adequate
- Follow the equipment manufacturer’s instructions
- Follow the instructions on the pesticide label
- Calibrate for uniformity and rate of application.

Figure 1 Field Sprayer Components illustrates the basic components of a field sprayer.

Figure 1 Field Sprayer Components



The operation of the application equipment may vary depending on:

- Type of equipment that you use
- Type of pesticide used
- Environmental conditions
- Proximity to sensitive areas
- Location of the pests on the host
- Proximity of bystanders, wildlife, pets and livestock.

A sprayer tank must be easy to clean. Any pesticide residues may damage other crops.

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Nozzles

Proper selection and operation of spray nozzles are important for accurate pesticide application, minimizing the amount of pesticides needed and reducing spray drift. You need to know the function and common types of nozzles so you can choose the correct nozzle for each spray job. If everything else is kept the same, the type of nozzle determines the spray pattern, the spray volume and droplet size.

Characteristics of common nozzle types are given below.

Tapered Flat-fan Nozzle

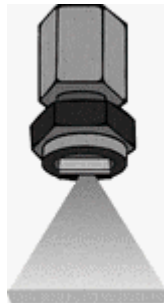


- Most common nozzle for farm sprayers
- Recommended by pesticide companies
- Uniform accurate application when nozzle patterns overlap
- Readily available
- Minimal drift at correct speed and pressure
- Used for broadcast spraying of solid seeded crops.

Extended Range Tapered Flat Fan

- A more modern version of the tapered flat fan which produces the same range of spray patterns at a much lower pressure.

Even Flat-fan Nozzle



- Identical to the tapered flat-fan but does not produce a tapered edge pattern
- Height above target plants is critical
- Used for row crop spraying to apply pesticide in bands or strips along the rows of plants.

Flooding-fan Nozzle



- Wears well and resists plugging
- Primarily used to apply liquid fertilizers and pre-emergence herbicides
- Large droplets, lower pressure and uneven pattern restrict its use for most post-emergence herbicide applications.

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Cone Nozzle



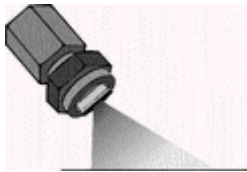
- Used for pre-emergence applications and aircraft spraying
- Does not provide an even consistent pattern with ground equipment
- Solid cones best suited for high-volume applications and high pressures.

Hollow Cone Nozzle



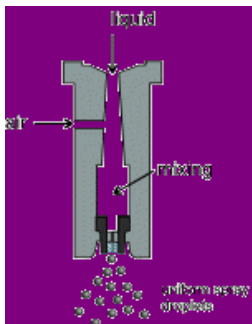
- Provides finer and more regular pattern than full cone nozzles
- More wear resistant with wettable powders.

Off-centre Nozzle



- Used as end boom nozzle or on boomless sprayers
- Use for areas too rough or inaccessible for boom sprayers
- Not recommended for crop spraying but good for spraying bush, roadsides and patches of rough terrain because no booms are required
- Pattern is very poor compared to other systems.

Venturi Nozzle



- Draws air into the spray stream to produce larger more uniform droplets that are much less subject to drift
- Works best at relatively high pressures.
- Depending on the tip used, can produce spray patterns for a variety of purposes
- Commonly used wherever spray drift is a concern.

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Nozzle material determines cost and wear.

Table 3 Nozzle Tip Material describes the various materials that make up nozzle tips.

Table 3. Nozzle Tip Material

Nozzle Tip Material	Features
Ceramic	<ul style="list-style-type: none">• Best choice in most situations due to better performance, less wear and cost savings• Easily damaged on impact.
Stainless Steel (regular or hardened)	<ul style="list-style-type: none">• Was the standard on farm sprayers for many years but wears out quicker than ceramic and some polymers at comparable cost• Less likely to be damaged on impact compared to other materials
Polymers (kemetal, hostaform and others)	<ul style="list-style-type: none">• Good resistance to wear, in many cases better than stainless steel• Easily damaged on impact or during handling
Brass	<ul style="list-style-type: none">• Low cost, but not recommended because of rapid wear• Suitable on sprayers used to treat small areas.

Replace nozzle tips when output varies by more than 5 percent of manufacturer's specification.

Select nozzles carefully because they affect sprayer performance and operation cost. Replace nozzles when the output varies by more than 5 percent of manufacturer's specifications. Softer nozzle materials, higher pressures and more abrasive formulations all result in more rapid nozzle wear.



Nozzle Wear

Tests have shown that brass tips should be replaced after only 20 acres if you are applying a wettable powder.

Sprayer Design for Operator Safety

There are many sprayer designs and accessories that improve environmental and operator safety during spraying. Remote control, monitoring equipment and GPS guidance make application accurate and convenient, while keeping the operator away from the spray or the pressure lines which could burst or leak.



Operator Safety Accessories

Check off the safety accessories that you use or might purchase.

- Electric solenoid operated controls
- Hydraulic booms
- Enclosed cabs with charcoal air filters

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- Electronic spray monitors
- GPS guidance systems.

Accessories used to reduce spray drift or pollution:

- Nozzle cones
- Boom shrouds
- Nurse tanks
- Anti backflow.

Several companies manufacture individual spray cones or boom shrouds that protect the spray pattern. This allows you to spray during higher wind conditions.

Safe Field Operations

Safe field operations require that spray solution be distributed evenly over the target area while minimizing drift and protecting water sources. Ensure operator and environmental safety.

Water Source

Hauling water to the sprayer using a nurse tank is the best way to prevent contamination of any water source. This ensures that you do not contaminate your water source by:

- Water siphoning from the spray tank back to the water source
- The tank overflowing
- Pesticide spilling near or into the water source or running down the sides of containers
- Dripping nozzles or leaks
- Pesticide washing off sprayer, tanks or trucks.

Ensure that water is clean and free of algae, silt or fine particles that could cause pump wear, nozzle wear, nozzle plugging or reduced pesticide activity.

Transportation to the Field

Fill the sprayer in the field to be sprayed, if possible. By adding chemical in the field you decrease the chance of spilling chemical into the environment. A spill during transport would be hard to contain and clean.

Weather Conditions

Consider air temperature, relative humidity and wind speed when you apply pesticides. They influence pesticide drift, effectiveness and crop tolerance. Pesticide drift can cause damage to crops, beneficial species, human health and the environment. Drift occurs when the droplet size is too small or the wind is too strong. These droplets remain airborne and are carried downwind. Vapor drift occurs after application when the pesticide begins to evaporate. Evaporation increases when temperatures are high and relative humidity is low. The best performance is obtained with light wind, high humidity and moderate temperature.

Spray Drift

Very small spray droplets or vapor always drift downward. Some drift is inevitable, which is one reason for buffer zones. Spraying in windy

Read the label for mixing instructions. Adding pesticides in the incorrect order can prevent otherwise compatible materials from mixing properly.

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conditions presents the greatest hazard. You can minimize wind drift of airborne pesticides (dust, spray droplets or fumes) toward nearby water, crops, livestock or residential areas by doing the following:

- Apply when wind speeds are low (less than 16 km/h)
- Apply when the relative humidity is greater than 40 percent
- Use venturi nozzles with proper boom pressure
- Reduce nozzle height and boom pressure while still maintaining correct application rates
- Use coarse spray droplets
- Apply when air temperature is below 30°C
- Use spray boom shrouds or cones.

You can minimize pesticide drift damage by keeping drift low and by spraying downwind of sensitive areas.

Vapor Drift

Minimize vapor drift:

- Select low volatile pesticides
- Apply pesticides when weather conditions do not favor evaporation (i.e., avoid high temperatures and low relative humidity)
- Properly seal bins when using aluminum phosphide
- Seal ground squirrel burrows when using aluminum phosphide
- Avoid atmospheric inversions.

Marker Systems

If your tractor or sprayer is not equipped with a GPS guidance system, use some type of visual marker to minimize overlap and misses as described in Table 4 Marker Systems.

Table 4. Marker Systems

Type of Marker	Time Mark Remains Visible
Foam blobs:	
• Self-mixed	15 minutes to 1 hour
• Pre-mixed	1 to 6 hours
Paint streaks or dyes	Several days
Discs or drags	Until rain
Paper strip dispensers	Several days

Spray Boom Operation

The spray boom positions the nozzle at the correct spacing and height to permit a uniform application. Any boom movement either vertically or horizontally will reduce the uniformity of pesticide application.



Improper Spray Boom Position

- Leaves untreated streaks and possible crop damage if the boom is too low
- Causes random crop damage and random misses when excessive speed, a rough field surface or lack of proper stabilization cause booms to bounce

The sprayer boom must be the proper height.

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- Produces areas of light and heavy application if the booms whip back and forth as would be caused by a loose hitch.

Sprayer Maintenance Practices

Proper sprayer maintenance results in longer sprayer life, trouble-free operation and most economical pest control. Improper or lack of maintenance can result in:

- Accidents
- Spills
- Personal exposure to pesticides
- Contamination of the environment
- Lost time
- Costs for replacement parts and repair.
- Crop loss due to spray damage or lack of pest control.

Table 5 Daily and Seasonal Maintenance for Sprayers describes daily and seasonal maintenance requirements for sprayers.

Table 5. Daily and Seasonal Maintenance for Sprayers

Empty and clean application equipment after each day's use, when changing pesticides and before off-season storage. In addition, follow the recommendations below.

Daily Maintenance	Seasonal Maintenance
<p>REMEMBER: Wear protective clothing while cleaning or maintaining the sprayer.</p> <p>Shut machinery off BEFORE making hazardous repairs or adjustments.</p>	<p>•Do not leave pesticide in the application equipment for an extended amount of time. Pesticide left in equipment can:</p> <ul style="list-style-type: none"> - Penetrate hoses, gaskets and plastic - Cause premature corrosion - Reduce the effectiveness of the pesticide - Result in suspensions settling out, creating mechanical problems.
<ul style="list-style-type: none"> •Check nozzle screens and clean if necessary 	<ul style="list-style-type: none"> •Completely drain and wash tank, filters, pump, pressure regulator, controls and any fittings that may retain water
<ul style="list-style-type: none"> •Clean equipment well away from wells and surface water 	<ul style="list-style-type: none"> •Check the sprayer for worn parts and order replacements
<ul style="list-style-type: none"> •Do not clean equipment where soil is sandy as groundwater may be affected by leaching of contaminated water 	<ul style="list-style-type: none"> •Before storing your sprayer for the winter, remove the pump and follow the manufacturer's recommendations on addition of antifreeze solutions
<ul style="list-style-type: none"> •Rinse the outside of the tank with detergent and water 	<ul style="list-style-type: none"> •Seal openings to prevent entry of dirt, debris or rodents
<ul style="list-style-type: none"> •Dispose of rinse water the same way you would dispose of surplus spray solution (on the field just sprayed, providing the label rate is not exceeded, or on non-cropland as long as it is authorized on the label) but away from water or sandy or gravel soil 	<ul style="list-style-type: none"> •Store the sprayer where it will not be damaged by other equipment or livestock; store polyethylene tanks under cover to prevent deterioration by sunlight.
<ul style="list-style-type: none"> •Thoroughly clean the tank lines, filters, nozzles and screen when changing pesticide if the new crop is not tolerant of the previously used pesticide. 	<ul style="list-style-type: none"> •Lock or secure the lid to prevent children climbing into the sprayer.

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Granular Pesticide Application Equipment

Granular herbicides and insecticides are usually used as soil applications in areas where residual control is required. Unlike spray and dust application, granules cause no problems with drift.

Correct calibration and operation are as important with granular products as they are with liquids and offer the same benefits.

Methods of Granular Application

- Broadcasting
- Even distribution over the ground surface
- Spot treatment
- Banded, furrow application or side-dressing
- Soil incorporation
- Drilling or soil injection.

The amount of granules applied per unit area by all types of equipment depends on:

- Size of the adjustable opening
- Speed of travel (except ground-driven equipment)
- Granular formulation
- Size and type of carrier
- Roughness of the application surface.

The biggest problem with granules is obtaining an even spread pattern. Granular applicators have lower accuracy than liquid applicators.

Maintenance of Granular Applicators

Proper maintenance of granular applicators minimizes the chance of a breakdown, increases the service life and increases accuracy in both rate and placement of the pesticide.

Ongoing Maintenance

- Make sure moving parts are not seized due to corrosion.
- Use frequent light lubrication on all moving parts. Excessive lubricant can accumulate granules, dust or dirt which causes rapid wear.

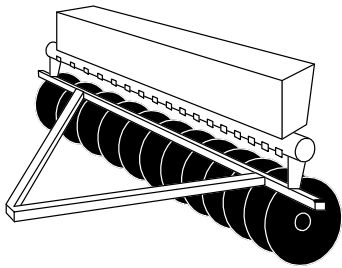
Seasonal Maintenance

- Thoroughly clean the equipment. Return unused granules to proper storage; do not dump them.
- Check for worn parts and order new ones.
- Store the equipment where it will not be damaged.

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Types of Granular Applicators

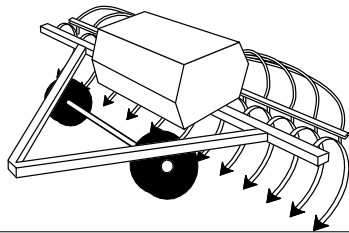
Gravity Applicators



With gravity applicators, the size of the openings regulates the flow to multiple outlets. This type of equipment is also used for fertilizer application. The output of gravity applicators is changed by rough field conditions.

A band applicator is a modification of the gravity-feed system. It drops granules through tubes and releases them onto the soil in bands.

Pneumatic Applicators



Pneumatic applicators use a combination of airflow and gravity to deliver granules. Pneumatic applicators are usually mounted on a tillage implement. Application and incorporation can be done in one trip and the tillage provides an accurate marker system to avoid double applications.

Many granular herbicides are broadcast and then worked into the soil. Some insecticides must be applied with the seed or alongside the seed in a furrow. Each product has different requirements that are satisfied by different types of equipment.

Equipment Calibration

Calibration is the procedure for checking and adjusting the delivery rate of the application equipment.

Calibration ensures your application equipment delivers:

- The correct amount of pesticide.
- The pesticide is distributed uniformly over the target.

Applying the correct amount of pesticide is important and environmentally responsible. Over application can result in increased costs, damage to the crop or the environment, increased exposure of the applicator and residues in the field restricting the next year's crop choices. Under application of pesticides can result in poor control of the pest, the need to re-treat the area, increasing application time and costs, and development of resistant pest species.

Even if the correct amount is applied, good control is not guaranteed. Control may be poor if application is patchy. Patchy application could also damage a crop.

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Uniform distribution is essential to good control and depends on:

- Accurate rate calibration
- Spray pattern uniformity
- Use of markers
- A modern sprayer.

Safety Precautions During Calibration

- Always calibrate with clean water
- Make sure all PTO and tractor shields are in place
- Calibrate your equipment away from any water source or open water.

Spray Pattern Uniformity

Variables that affect spray pattern uniformity across the swath widths include:

- Nozzle height
- Nozzle fan angle
- Nozzle type
- Nozzle pressure
- Nozzle size
- Nozzle material and manufacturer.

Pre-calibration



Pre-calibration Checklist

Use the following checklist to ensure your sprayer is ready to be calibrated.

- The tank is clean
- Filters are clean
- The pressure gauge is accurate
- The pressure at nozzle tips is almost as high as at the pump
- The correct nozzles have been installed
- The boom height is appropriate for the nozzle angle, overlap and height of the crop
- The nozzles are clean and undamaged; any worn nozzles are replaced
- Nozzle screens are clean and undamaged
- Pressure is at 275 Kpa.

Discard any nozzle that produces visible streaks or a lopsided pattern. Collect output from each nozzle for one minute and compare to the manufacturer's chart (see Table 6 Manufacturer's Nozzle Chart). Replace any nozzles that vary more than 5 percent.

Your sprayer is now working properly and is set up to deliver a uniform spray pattern across the swath width.

Calibration Steps

Step 1. Determine travel speed

From the label, find the volume of spray solution recommended in L/ha or L/acre.

Refer to the manufacturer's nozzle chart (see Table 6) and select the speed that gives you that volume.

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Travel Speed

If you want to apply 40 L/acre and you are using 11002 nozzles at 275 KPa, you would travel at 9 km/h.



Travel Speed

At what speed would you travel if you wanted to apply 35 L/acre and are using 11015 nozzles at 275 kPa.

Answer: 8 km/h

Table 6. Manufacturer's Nozzle Chart

Manufacturer's Nozzle Chart (Based on Spraying Water) 110° Spray Angle									
Nozzle Tip	Pressure KPa	Liter/Minute	Liters Per Acre (50 cm Nozzle Spacing)						
			km/hour						
			6	7	8	9	10	11	12
11001	200	.32	26	22	20	17	16	14	13
	275	.38	30	26	26	20	18	16	15
	300	.39	32	27	24	21	19	17	16
110015	200	.48	39	33	29	26	23	21	20
	275	.57	46	39	35	31	28	25	23
	300	.59	48	41	36	32	29	26	24
11002	200	.65	23	44	40	34	32	28	26
	275	.76	62	52	46	40	36	32	30
	300	.79	64	54	48	42	38	34	32
11003	200	.97	79	68	59	53	47	43	40
	275	1.15	93	80	70	62	56	51	47
	300	1.18	96	82	72	64	58	52	48
11004	200	1.30	105	88	80	68	64	56	52
	275	1.52	123	104	92	80	72	64	60
	300	1.58	128	108	96	84	76	68	64

Step 2. Check the speed in the field

Table 7 Speed Chart provides you with data to convert the time it takes to travel a set distance in the field to km/h.

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Table 7. Speed Chart

Speed Km/h	Seconds to drive	
	60 meters	90 meters
5.0	45	68
5.5	39	58
6.0	37	54
6.5	34	51
7.0	30	45
8.0	27	41
9.0	24	36
10.0	23	34
11.0	19	29
12.0	18	27
13.0	17	25
14.0	15	23
16.0	14	20

Step 3. Calculate the amount of pesticide and water to mix

Filling a Completely Empty Tank

Procedure	Example	Exercise
Determine sprayer tank capacity	1800 L	1200 L
Determine spray volume from label	40 L/acre	30 L/acre
Calculate acres covered per tank	$1800 \text{ L} \div 40 \text{ L/acre} = 45 \text{ acres/tank}$	_____
Determine recommended application rate from label (rate/acre)	0.6 L/acre	.5 L/acre
Calculate amount of pesticide to add to the tank	$0.6 \text{ L/acre} \times 45 \text{ acres} = 27 \text{ L}$	_____
Fill the tank with water	1773 L (1800L/tank – 27 L pesticide)	_____ (____ - ____)

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Preparing a Partial Tank of Mixture

Procedure:	Example
Determine area to be sprayed	25 acres
Determine spray volume from label	40 L/acre
Calculate amount of spray solution required	40 L/acre x 25 acres = 1000 L
Determine recommended application from label (rate/acre)	0.6 L/acre
Calculate amount of pesticide to add to the tank	0.6 L/acre x 25 acres = 15 L
Calculate amount of water to add to tank	1000 L – 15 L = 985 L (water)

You then add 985L of water plus 15L of pesticide to make the total spray required of 1000 L of spray solution in the tank.

If you wish to adjust the output rate, use one of the recommended methods below.

Changing the Output Rates

Large changes in spray rate

- Change the nozzle size rather than adjust pressure. The proper pressure must be maintained to control drift and retain the proper spray pattern.

Small changes in spray rate

- Change your speed. Application rate is directly proportional to the speed. The higher the speed, the lower the application rate. Most sprayers are operated between 6 and 10 km/h. Faster speeds may cause the booms to bounce, destroying the uniform pattern you want.

Minor changes in spray rate

- Change pressure to adjust for losses in pressure between the pressure gauge and the nozzles. Do not change pressure more than 10 percent from manufacturer's specifications because:
 - Higher pressure increases the number of fine spray droplets, increasing the risk of drift
 - Lower pressure distorts the spray pattern and causes uneven applications.

A combination of changes may be necessary to get the adjustment you want.

Calibrating Backpack or Hand Sprayers

The spray volume that a small sprayer will apply is determined by field testing.

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The size of the test area commonly used is 1/100 of an acre. The test area surface must be the same as the spray area so the walking speed will remain the same.

There are four steps in calibrating a small sprayer.

Steps for Calibrating a Sprayer

1. Measure a test distance to spray 1/100 acre (40.5m²) according to the swath width of the sprayer.

Swath Width (m)	Test Run Length (m)
0.5	81.0
1.0	40.5
1.5	27.0
2.0	20.2

2. At a comfortable walking speed, spray the test area and measure the volume of water used. Repeat two or three times to obtain an average.

Example: 2 L

3. Multiply the figure arrived at in Step 2 by 100 to get the spray volume per acre.

Example: 2 L x 100 = 200 L/acre

4. Calculate the amount of pesticide to add to each tank load.

Divide the spray volume per acre by tank capacity to determine the number of fills required to spray an acre.

Example: At 200 L/acre with a 20 L/tank you need 10 fills (200 ÷ 20) to spray an acre.

Divide the chemical rate per acre by the number of tank loads required to spray an acre to find how much chemical to add to each tank.

Example: If the label calls for 1 L/acre and you need 10 fills to spray an acre, you need 0.1 L of chemical per tank load (1/10=0.1 L).

Calibrating Granular Application Equipment

Calibrating granular applicators is similar in many ways to calibrating a sprayer; however, the technique is slightly different.

- With granular applicators you usually do not have untreated granules, the equivalent of clean water. You calibrate using the actual pesticide.
- There are no calibrated nozzles to put out a specified volume; you adjust gates, sprockets or gears, etc.
- Use the operator's manual to make the first setting or obtain settings from your chemical supplier for the product you are using. These settings will approximate the rate to apply but you refine the setting as you are applying the granules.

MODULE 7 PESTICIDE APPLICATION AND EQUIPMENT CALIBRATION



Calibrating Granular Applicators

You are planning to apply Treflan QR5 granules in the fall on a soil with high organic matter. The label rate is 11.3 – 13.7 kg/acre. If you select to apply 12.5 kg/acre, each 25 kg bag would do 2 acres.

You can roughly set any granular application by the following method:

1. Measure off 100 m in the field
2. Collect the output from any four openings by taping a bag over each opening, and drive the machine over the 100-m course.
3. Combine the contents of the four bags and weigh in g.
4. Measure the spacing between openings in cm

$$\text{Kg/acre} = \frac{\text{weight of material collected (g)}}{\text{spacing in cm}}$$

Review Checklist

Check your understanding of the material in Module 7.

- I am able to match sprayer equipment to the proper use.
- I am able to choose a nozzle that suits the spraying job.
- I know how to protect my water source when filling the sprayer.
- I know the precautions to take to reduce spray drift.
- I can list the daily and seasonal maintenance procedures for my sprayer.
- I understand the need for correct calibration and operation of granular pesticide application equipment.
- I understand the precautions necessary during sprayer calibration.
- I am able to carry out the three steps to calibrate a field sprayer.
- I am able to carry out the four steps to calibrate a small sprayer.
- I know how to calibrate granular application equipment.

If you can not check off the above items, review the appropriate sections.

MODULE 7 PESTICIDE APPLICATION AND EQUIPMENT CALIBRATION

Exercises

Exercise 7.1

Mark each statement True (T) or False (F)

- a. Agitation is not important if the herbicide is sprayed immediately
- b. Agitation is critical for some formulations of pesticides
- c. The mixing produced from moving a sprayer from one location to another is adequate to produce a uniform solution

Exercise 7.2

Check the correct answers

An agitator on a sprayer is necessary:

- a. Because it makes the pesticide solution foam and increase in volume
- b. Only when using emulsifiable concentrate solutions
- c. To keep the spray solution uniformly mixed
- d. In case of application delay, mixed tank solutions will remain unaffected for several hours if there is continuous agitation

Exercise 7.3

Mark each statement True (T) or False (F)

- a. Venturi nozzles produce a more uniform droplet size compared to conventional nozzles
- b. Nozzle output and spray droplet size are not related to pressure or nozzle wear
- c. Cone nozzles and off center nozzles do not provide an even consistent pattern and therefore are not recommended for in crop spraying

MODULE 7 PESTICIDE APPLICATION AND EQUIPMENT CALIBRATION

Exercise 7.4

Mark each statement True (T) or False (F)

- a. Ceramic nozzles wear more slowly than nozzles made of other materials
- b. A damaged nozzle that is putting out the correct volume of spray does not need to be replaced
- c. Wettable powders are more abrasive, requiring the nozzles to be changed more often

Exercise 7.5

Mark each statement True (T) or False (F)

- a. Rinsing a sprayer with bleach or ammonia is only necessary at the end of the spray season
- b. Cleaning nozzles, screens, tank and hoses will prevent blockages and ensure uniform consistent pressure and therefore uniform application of pesticides
- c. Neoprene or nitrile gloves and neoprene or nitrile boots should be worn at all times when cleaning sprayer parts
- d. Once you have finished spraying for the season, it is important to clean and store your sprayer properly

Exercise 7.6

Mark each statement True (T) or False (F)

- a. Calibration and proper markers are not as important in granular application as in liquid application
- b. Granular applicators are available in gravity and pneumatic models and can be implement mounted, skid mounted or on pull type trailers
- c. The biggest problem with granules is obtaining an even spread pattern; granular applicators have lower accuracy than liquid applicators
- d. One advantage to using a granular applicator is that, unlike a sprayer, granular applicators do not need to be calibrated for different granular formulations

MODULE 7 PESTICIDE APPLICATION AND EQUIPMENT CALIBRATION

Exercise 7.7

Mark each statement True (T) or False (F)

- a. Lack of calibration or improper calibration can result in applications of less than recommended rates on labels
- b. Spray volume is the amount of solution discharged per unit area (for example, L/acre)
- c. PTO and tractor shields should be in place when calibrating equipment

Exercise 7.8

Your sprayer has nozzles with an operating pressure ranging from 200 – 300 kPa. You are going to apply a herbicide that specifies a spray volume of 45 L/acre.

Based on Table 6 Manufacturer's Nozzle Chart, select a combination of speed and pressure that will put on the correct amount if your nozzles are of the 11002 type.

Pressure	kPa	Speed	km/hr
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Exercise 7.9

List the three principal factors that determine the application rates of a given spray mixture:

1.

2.

3.

MODULE 7 PESTICIDE APPLICATION AND
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Exercise 7.10

Calculate the two answers needed in this example and fill in the blanks.

Sprayer tank capacity 2200 L

Spray volume of 11002
nozzle at 275 kPa and 9 40 L/acre
km/hour

Calculate acres covered
per tankful $2200 \div 40 \text{ L/acre} = \text{(a)} \underline{\hspace{2cm}}$ acres

Determine
recommended rate 20 g/acre (of actual dry flowable)

Calculate amount of
pesticide to add to tank $20 \text{ g/acre} \times \text{(a)} \underline{\hspace{1cm}} \text{ acres} = \text{(b)} \underline{\hspace{1cm}} \text{ g}$

Calculations:

MODULE 7 PESTICIDE APPLICATION AND EQUIPMENT CALIBRATION

Answers

Answer 7.1

- a. False
- b. True
- c. False

Answer 7.2

C & D

Answer 7.3

- a. True
- b. False
- c. True

Answer 7.4

- a. True
- b. False: a worn or damaged nozzle can put out the correct volume of spray but the pattern may be irregular
- c. True: wettable powders can be very abrasive

Answer 7.5

- a. False: the bleach or ammonia both cleans the sprayer and helps break down pesticide residue. This is very important when changing pesticide or spraying a different crop.
- b. True: a small blockage will affect pressure and this can distort spray patterns
- c. True: always wear neoprene or nitrile boots when working with pesticides. Leather absorbs and retains pesticides; neoprene or nitrile gloves are standard equipment to prevent exposure to hands and arms while working.
- d. True

Answer 7.6

- a. False
- b. True
- c. True
- d. False

Answer 7.7

- a. True
- b. True
- c. True

Answer 7.8

- a. There are several combinations: 200 kPa at 7 km/hour or 275 kPa at 8 km/hour are both very close

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Answer 7.9

Nozzle size
Wear of nozzle orifice
Plugged or restricted nozzle

Answer 7.10

- a. 55
- b. 1100 gm