Lesson Number 8

Title: Applying Pesticides Safely and Effectively

Purposes / Objectives

To demonstrate how farmers apply liquid pesticides to crops.
To identify effective application devices and methods.

To identify the parts of a backpack sprayer (pulvérisateur).
To describe the function and purpose of each part.
To explain the use of strainers in a spraying system.
To demonstrate the pattern of a hollow cone nozzle.
To identify the parts of a nozzle assembly.
To learn how to clean and care for sprayers and nozzles.

To explain why it is important to apply the correct amount of pesticide to a crop.
To apply the correct amount of Decis.

Overview

In this activity, the farmers will use the pesticide applicators they have to show how they apply liquid pesticides to their horticultural crops. The FFS formateurs will treat the same crop with a backpack sprayer.

Water with blue marker dye added will be used instead of pesticide. The blue dye will show which method provides the best crop coverage. It will also show any off-target applications or spills.

The farmers will examine the backpack sprayer. The FFS formateurs will identify and name the parts of the sprayer. The farmers will describe the purpose of each part.

The FFS formateurs will show the parts of the nozzle assembly: hollow cone nozzle, gasket, strainer, and cap. The farmer will describe the purpose of each part.

Finally, the formateurs will tell the farmers that the TXA 8004 Cone Jet Hollow Cone Nozzle can apply the amount of Decis the label specifies.

This lesson is also a good time to model safe and proper pesticide handling. The blue dye will show leaks, spills, and splashes onto nontarget plants, places, or people. If possible, remind the growers about the importance of reducing exposure, and how to accomplish that goal:
- working carefully,
- using good equipment, and
- wearing protective clothing.
Please note that the blue colorant is non-toxic. It will not harm people or crops. It breaks down in sunlight. Treated crops will not be stained. Washing will remove it from clothes and skin.

**Advance Planning**

Ask farmers to bring what they use to apply liquid pesticides to their crops to the class. Ask them to clean/rinse the device before bringing it. If possible, be sure at least three types of applicators are compared: a small, hand-held pump atomizer (atomiseur), a makeshift device (ex. watering can and/or a broom if farmers use them), and a backpack sprayer (pulvérisateur).

Choose an area to spray with water and dye. You will need one plot or row for each type of applicator shown in the lesson. The plots you treat should be close enough to compare, but far enough apart so the liquid applied to one section or row will not splash or spray onto another area.

Obtain a backpack sprayer (pulvérisateur), a hollow cone nozzle, and some of the special blue dye.

Obtain an empty, rinsed Decis can.

**Materials**

- Paper
- Pencil
- Copies of the charts on pages 3 and 4
- Protective clothing (gloves, boots)
- Application equipment used by farmers (atomiseur, other?)
- Backpack sprayer (pulvérisateur) with hollow cone nozzle
- Empty, rinsed Decis can
- Blue Marker dye
- Measuring tape (distance)
- Measuring containers (volume)
- Funnel
Methods and Results

Part #1: Comparison / evaluation of liquid pesticide application methods:

Select an area to treat. Have one section or row for each type of applicator. The sections or rows must be close enough to see and compare easily, but far enough apart so the liquid applied to one section does not splash or drift to another.

Draw some water, and add blue dye to it. Load some of the water + dye mixture into each of the application devices: atomiseur, watering can or broom (if used), and pulvérisateur.

Treat a section or row of green beans (or other horticultural crop.)

Study the patterns made by the blue dye on the leaves of the treated crop -- and on the ground if some falls there. Ask the farmers to make drawings to show how each device covers a plant leaf in the charts that follow.

<table>
<thead>
<tr>
<th>Applicator</th>
<th>Coverage (drawing showing dye pattern)</th>
<th>Advantages (Good Points)</th>
<th>Disadvantages (Bad Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomiseur</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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<td>------------</td>
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<tr>
<td>Pulvérisateur</td>
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Read the *Préparation* section of a Decis can label to the growers. Point out the differences in the application rates for an atomiseur compared to a pulvérisateur:
- If using an atomiseur, mix 100 mL of Decis in 10 L of water.
  (100 mL in 10,000 mL = 1 mL Decis : 100 mL water = 1:100 ratio.)
- If using a pulvérisateur, mix 35-40 mL Decis in 15 L of water.
  (35-40 mL in 15,000 mL = 1 mL Decis : 375-430 mL water ≈ 1:400 ratio.)
Point out that you can use less Decis per area if you have a pulvérisateur. The rate for an atomiseur is 4X greater!

After hearing about the difference in application rate (atomiseur vs. pulvérisateur), study the blue dye patterns in each treated section. Make drawings of each applicator’s coverage pattern. Lead a discussion of the advantages and disadvantages of each applicator. Add these answers to the charts above.

Ask them why they can use less Decis per area if they use a pulvérisateur rather than an atomiseur. (The pulvérisateur provides better coverage.)
Here are some advantages and disadvantages of each type of applicator. You and the farmers may think of more.

The atomiseur is small, simple, and easy to use. It is inexpensive. However, a farmer can only treat a small area at a time (because the tank is small.) This means more handling (mixing and loading), which means more chance for exposure. The droplets an atomiseur produces are small and fine. Some blow away. It is difficult to cover plant surfaces completely with the spray from an atomiseur. Few if any of the droplets reach the underside of leaves or lower leaves. Some pests will not be affected. Farmers must use a stronger Decis solution if they use an atomiseur (one part Decis to 100 parts water.)

A broom is simple to use. It is very inexpensive. However, liquid is applied in streaks. Coverage is uneven. It is difficult or impossible to treat the lower parts of plants. Some pests will not be affected. A broom is not designed to apply pesticides.

A watering can is designed to water plants. As a pesticide applicator, it may provide good coverage. However, much of the solution applied from the watering can falls to the ground. Once there, a pesticide solution is not useful, because the insects that damage crops do not consume soil or rest on the ground. Pesticide solution that falls to the ground may move into the soil. Once there, it may cause harm to beneficial organisms or contaminate water supplies. A watering can is not designed to apply pesticides.

The pulvérisateur is fairly small. It is simple, and easy to use. It is expensive. However, a farmer can treat a large area at one time (because the tank is large.) This means less handling (mixing and loading), which means less chance for exposure. The long spray wand allows the farmer to reach plants in the middle of a section. This reduces the chance for exposure, because the farmer’s hand is not close to the spray. The droplets are medium sized…not tiny like those from an atomiseur, not large like those from a watering can. It is easy to cover plant surfaces completely with the spray from a pulvérisateur. Pulvérisateurs have special nozzles (hollow cone nozzles) that are designed to apply insecticides to plants. Many of the droplets reach the underside of leaves and the lower leaves of the plants. So, most or all of the pests on the plants will be affected. Farmers can use a weaker Decis solution if they use a pulvérisateur (one part Decis to 400 parts water.) This saves money. It makes it easier to apply the correct amount of Decis, without risking applying too much and having the crop rejected due to high pesticide residues.

Part #2: Parts of a Pulvérisateur:
Show the backpack sprayer (pulvérisateur) to the farmers. Tell the farmers the name of each part. Ask them to describe the purpose (function) of each part.

<table>
<thead>
<tr>
<th>Pulvérisateur Part</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston pump</td>
<td>Provide pressure to force the spray out</td>
</tr>
<tr>
<td>Pump lever</td>
<td>Build pressure</td>
</tr>
<tr>
<td>Tank</td>
<td>Hold the pesticide solution</td>
</tr>
<tr>
<td>Cap</td>
<td>Keep the pesticide in the tank</td>
</tr>
<tr>
<td>Strainer (cap)</td>
<td>Catch particles that might clog the sprayer hose, tube, or nozzle</td>
</tr>
<tr>
<td>Filter (spray wand)</td>
<td></td>
</tr>
<tr>
<td>Agitator</td>
<td>Keep pesticide solutions mixed up</td>
</tr>
<tr>
<td>Spray Wand with on/off controls</td>
<td>Apply pesticides, reach areas to be treated</td>
</tr>
<tr>
<td>Nozzle Body*</td>
<td>Produce droplets of proper size, pattern to give good coverage</td>
</tr>
<tr>
<td>Straps</td>
<td>Hold the pulvérisateur securely on the back</td>
</tr>
</tbody>
</table>

Sprayers may not need cleaning after each use if they are well cared for and if they are always used to spray the same pesticide. If pesticide spills on them, they must be cleaned. Before putting them away for the season, they should be rinsed well with clean water. Do not put herbicides in a sprayer that is used to apply insecticides and fungicides. If one sprayer is used for several kinds of insecticides and fungicides, do not risk contaminating a crop by using a sprayer that has not been cleaned out. Do not risk plugging nozzles or hoses by letting a sprayer get dirty.

Part #3: Parts of a Nozzle Assembly:
Show the nozzle assembly to the farmers. Tell the farmers the name of each part. Ask them to describe the purpose (function) of each part. Show them how to take the nozzle assembly apart and put it back together on the end of they sprayer wand.

Show them how to clean a clogged nozzle with a special brush. (A tip cleaning brush will remove dirt and small particles that may plug a nozzle without harming the nozzle or changing the size of the opening. If the opening is damaged, the pattern, flow rate, and droplet size will change…and no longer be correct for the job.)

<table>
<thead>
<tr>
<th>Nozzle Assembly Part</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nozzle</td>
<td>Produce the pattern and proper size droplet</td>
</tr>
<tr>
<td>Gasket</td>
<td>Prevent leaks</td>
</tr>
<tr>
<td>Strainer</td>
<td>Prevent dirt from clogging the nozzle</td>
</tr>
<tr>
<td>Cap</td>
<td>Hold the nozzle onto the spray wand</td>
</tr>
<tr>
<td>Tip Cleaning Brush</td>
<td>used to unplug a nozzle without damaging it</td>
</tr>
</tbody>
</table>

Part #4: Application Amount:

The TXA 8004 Cone Jet Hollow Cone Nozzle can apply the right amount of Decis to a crop like green beans.

Hollow cone nozzles like the TXA 8004 Cone Jet are designed to apply insecticides to plants. The pattern produced by this nozzle is a hollow cone. Spray a mixture of water + blue dye with this nozzle and allow the growers to observe the pattern.

At slow walking speed (2 mph), this nozzle has a flow rate of approximately 4.25 liters per 100 square meters (using the sprayer with a medium pressure.)

This matches the application rate directed by the Decis label:

35-40 mL in 15 L per 350-400 m²

If farmers who use Decis:
- mix the right amount,
- walk slowly, spraying as they walk,
- work the pump lever to achieve medium pressure, and
- use a pulvérisateur fitted with a TXA 8004 Cone Jet hollow cone nozzle, the application should be at the correct rate.

Here are some things that may be discussed during this lesson:
Pesticides, Application Equipment, and Exposure:

If you notice blue dye on people’s hands, feet, or clothing, point it out. Discuss how the exposure happened. Discuss ways to prevent exposure.

Pesticides, Application Equipment, and Food Tolerances:

Remind the growers that:
- only certain pesticides are allowed on an export crop, and
- the allowed pesticides have limits -- if too much of an allowed pesticide is found on a crop, the crop will not be accepted.

Using good equipment in the proper way will help them control pests effectively without using a great amount of pesticide.

Summary and Conclusion

1. Summarize and review the growers’ responses. Be sure all the points they want to make and any questions they ask are recorded.

2. End the lesson by thanking them for their time and participation.

Notes

Decis Rate: *Préparation* Section of Label
35-40 mL in 15 L per 350-400 m² ≈ 1 oz in 4 gallons to treat 3780 ft²

**Calculations: Decis Rate w/ Sprayer (Pulvérisateur)**

35-40 mL in 15 L per 350 m² ≈ 1 oz in 4 gallons to treat 3780 ft²
10-11 mL in 4.25 L per 100 m² ≈ 1/4 oz in 1 gallons to treat 1000 ft²

2-3 mL in 1L to treat 23.3 m²
(4.8m x 4.8m; ≈ 1m x 23m; ≈ 2m x 11.5m ≈ 3m x 7.8 m; ≈ 4m x 6m)

5 mL in 2L to treat 46.6 m²
(6.8m x 6.8m; ≈ 1m x 46.6m; ≈ 2m x 23.3m ≈ 3m x 15.5 m; ≈ 4m x 12m)

6 mL in 2.5L to treat 58.3 m²
(7.6 m x 7.6 m; ≈ 1m x 58.3 m; ≈ 2m x 29.15 m ≈ 3m x 19.4 m; ≈ 4m x 14.6m)

7 mL in 3L to treat 70 m²
(8.4m x 8.4m; ≈ 1m x 70m; ≈ 2m x 35m ≈ 3m x 23.3 m; ≈ 4m x 17.5m)

9-10 mL in 4L to treat 93.3 m²
(9.7m x 9.7m; ≈ 1m x 93.3m; ≈ 2m x 46.7m ≈ 3m x 31.1 m; ≈ 4m x 23.3m)

**Conversions:**
1 m ≈ 3 feet

1 m² ≈ 10.8 ft²

\[ \text{m}^2 \times 10.8 = \# \text{ ft}^2 \]
\[ \text{ft}^2 \times 0.093 = \# \text{ m}^2 \]

18.6 m²  ≈  200 ft²
(4.31 m x 4.31 m)  (14.14 ft x 14.14 ft)
(2 m x 9.3 m)      (4 ft x 50 ft)

93 m²   ≈  1,000 ft²
(9.64 m x 9.64 m)  (31.62 ft x 31.62 ft)
(5 m x 18.6 m)     (20 ft x 50 ft)

350 m²  ≈  3,780 ft²
(18.7 m x 18.7 m)  (61.5 ft x 61.5 ft)
(5 m x 70 m)       (20 ft x 189 ft)

30 ml ≈ 1 oz

10 L ≈ 2.5 gallons = 2.64 gallons

\[ \text{gallons} \times 3.785 = \text{liters} \]
\[ \text{liters} \times 0.264 = \text{gallons} \]

Course Layout:
Swath Width of a Linear Course Length to = 25 m² (x 17.5 = 350 m²)
Swath Width of a Linear Course Length to = 35 m² (x 10 = 350 m²)
Swath Width of a Linear Course Length to = 70 m² (x 5 = 350 m²)

Using a TXA 8004 Cone Jet Hollow Cone Nozzle - 2 MPH walking speed

<table>
<thead>
<tr>
<th>Swath Width (cm / m)</th>
<th>Linear Distance for:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 m²</td>
<td>35 m²</td>
<td>70 m²</td>
<td></td>
</tr>
<tr>
<td>30 / 0.3</td>
<td>66.7 m</td>
<td>116.6 m</td>
<td>233.5 m</td>
<td></td>
</tr>
<tr>
<td>40 / 0.4</td>
<td>50.0 m</td>
<td>87.5 m</td>
<td>175.0 m</td>
<td></td>
</tr>
<tr>
<td>50 / 0.5</td>
<td>40.0 m</td>
<td>70.0 m</td>
<td>140.0 m</td>
<td></td>
</tr>
<tr>
<td>60 / 0.6</td>
<td>33.3 m</td>
<td>58.3 m</td>
<td>116.7 m</td>
<td></td>
</tr>
<tr>
<td>70 / 0.7</td>
<td>28.6 m</td>
<td>50.0 m</td>
<td>100.0 m</td>
<td></td>
</tr>
<tr>
<td>80 / 0.8</td>
<td>25.0 m</td>
<td>43.8 m</td>
<td>87.5 m</td>
<td></td>
</tr>
<tr>
<td>90 / 0.9</td>
<td>22.2 m</td>
<td>38.9 m</td>
<td>77.8 m</td>
<td></td>
</tr>
<tr>
<td>100 / 1.0</td>
<td>20.0 m</td>
<td>35.0 m</td>
<td>70.0 m</td>
<td></td>
</tr>
<tr>
<td>110 / 1.1</td>
<td>18.2 m</td>
<td>31.8 m</td>
<td>63.6 m</td>
<td></td>
</tr>
<tr>
<td>120 / 1.2</td>
<td>16.7 m</td>
<td>29.2 m</td>
<td>58.3 m</td>
<td></td>
</tr>
<tr>
<td>130 / 1.3</td>
<td>15.4 m</td>
<td>26.9 m</td>
<td>53.8 m</td>
<td></td>
</tr>
<tr>
<td>140 / 1.4</td>
<td>14.3 m</td>
<td>25.0 m</td>
<td>50.0 m</td>
<td></td>
</tr>
<tr>
<td>150 / 1.5</td>
<td>13.3 m</td>
<td>23.3 m</td>
<td>46.7 m</td>
<td></td>
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