Prince Edward Island
CANADA
Environment, Energy and Forestry

Seed and Seed Piece Treatments

Pesticide Applicator Training Manual

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Seed and Seed Piece Treatments

Seed piece treatment pesticides are applied to enhance the viability and performance of the seed or plant as it grows. This training material will focus on the application of seed treatments to potato seed pieces and cereal grains.

Learning Objectives

Completing this training material will help you to:

- Identify types and components of common seed treaters.
- Apply seed piece treatments in compliance with label directions.
- Clean and maintain seed treaters.
- Protect human health and safety.

General Objectives

As with any pesticide application, the general objectives are the same. These include:

- Apply the correct amount of product.
- Apply the product in a manner that optimizes performance.
- Apply the product in a manner that minimizes environmental impacts.
- Apply the product in a manner that maximizes your safety and the safety of your co-workers.

The treatment of seed is similar in many ways to the field application of a pesticide. However, when conducting a seed treatment, the equipment is stationary and the seed moves through it. The seed flow rate has the same effect on the pesticide application rate as the tractor speed does on a field application. This training material will discuss how to measure seed flow rates and properly calibrate seed treatment equipment**.**

The treatment equipment used depends upon the pesticide's formulation (dust or liquid) and the type of seed (potato or cereal). This training material will discuss the common equipment used for different crop and formulation combinations.

For most potato and grain operations, seed treating is done inside a building to protect workers and the seed from the weather. Working inside a building introduces an array of concerns. This training material will discuss the health risks associated with the indoor treatment of seed and identify means to protect yourself and others.

Characteristics of Seed Treatments

Pesticide Groupings

Most seed treatments are fungicides designed to protect the seed piece from disease during germination and early growth. Other seed treatments are formulated with an insecticide to protect the seed or the growing plant from insects.

Labels for fungicide seed treatments generally recommend thorough coverage of the seed piece. If a part of a seed's surface has no treatment on it, the potential for disease or pest problems increases. To optimize control, complete coverage of the seed piece surface is required.

Types of Formulations

Seed treatments are manufactured as dust or liquid formulations. Dusts are ready for use straight from the manufacturer's container. The majority of dusts are fungicidal based products used to treat potato seed pieces. Some dust treatments can also include an insecticide. Using these products requires that extra safety measures be taken.

Liquid formulations are used in both potato and cereal seed treatments. Check the pesticide label to determine if they are to be used as formulated or diluted with water. The equipment used to apply a liquid differs between potato seed pieces and cereal grains.

Colourants

Many liquid cereal seed treatments incorporate a colourant into the formulated product. The colour alerts people that a pesticide has been applied to the seed. The labels for some non-coloured treatments may require that colour be added when the pesticide is applied to seed. In cereal treatments, the colourant allows a visual assessment of surface coverage.

Most dusts do not contain a colourant in their formulation. After the dust is applied to potato seed pieces, an opaque whitish color can form on the surface. This slight colour change can sometimes help to identify if potato seed pieces have been treated.

Consult the pesticide label to determine if the treated seed needs to be labeled. Before handling any seed that is coloured or has a surface coating, you need to determine what pesticide has been applied. Always check the product label and wear the required personal protective equipment.

Application Equipment

Application of Potato Seed Piece Treatments - Dusts

When applying dry potato seed piece treatment (PSPT) pesticides to potato seed pieces, there are two basic types of treaters to choose from:

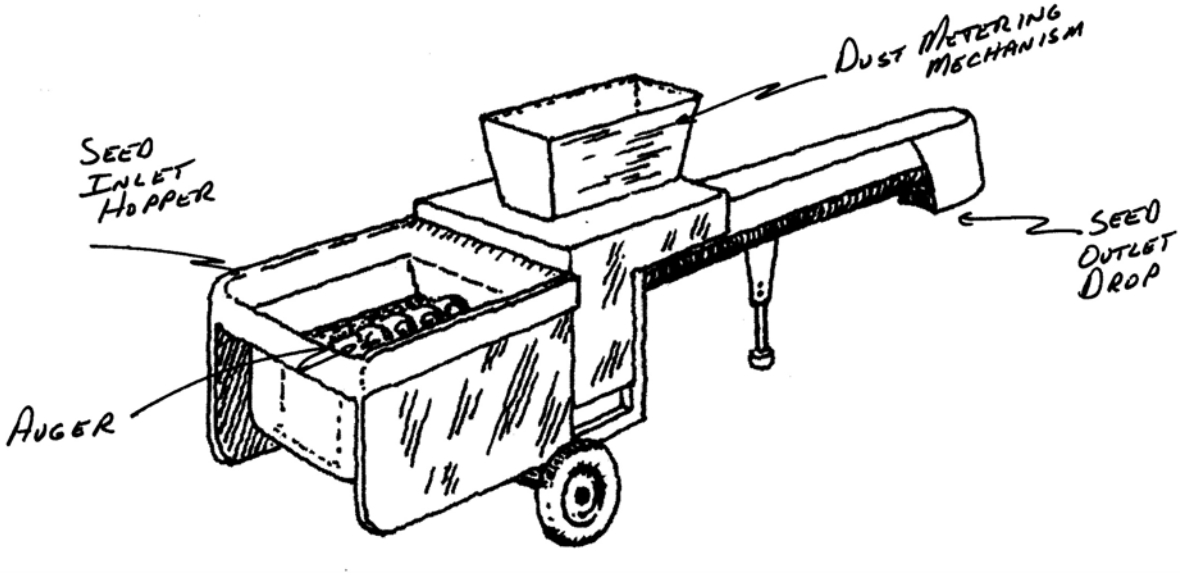
- the auger seed treater
- the drum seed treater

The basic difference between these treaters is clearly stated by their descriptive names. Treater manufacturers offer models with different capacities. Always select a model that matches the output of the set cutter. If the capacity of the treater is exceeded, reduced performance can occur.

Auger Seed Treater

An auger treater consists of four main parts, namely the:

- seed inlet hopper
- auger
- dust metering mechanism
- seed outlet drop



Basic Operation

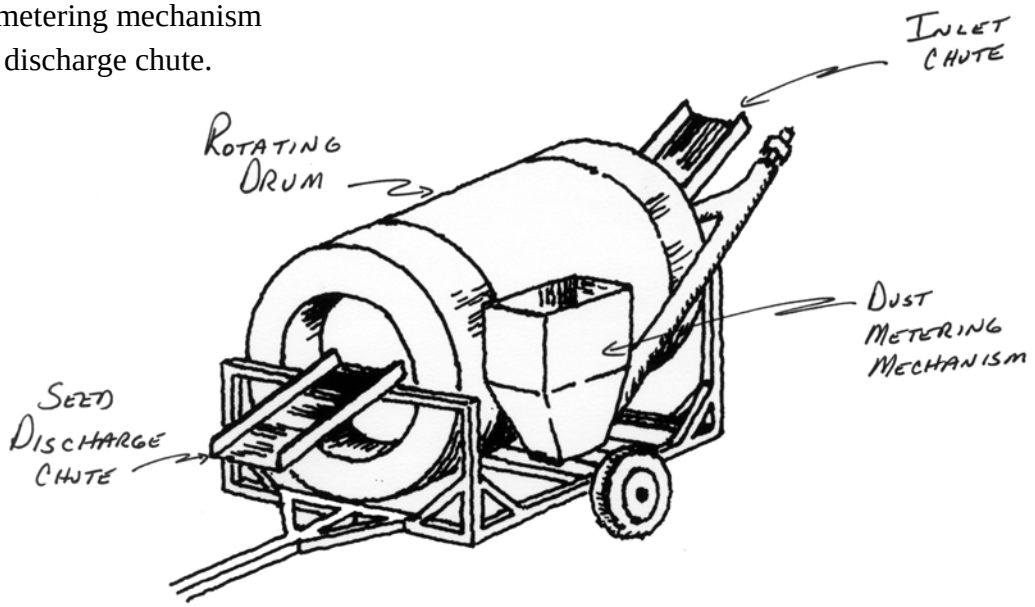
Auger seed treaters are relatively simple machines. The potatoes fall into the inlet hopper, which has several exposed auger flights at the bottom. After the inlet hopper, the top side of the auger casing is cut away so that dust from the metering mechanism can fall onto the sets. At the bottom of the dust hopper, the top portion of a long, steel roller is visible. The roller slowly rotates toward a slide gate running the length of the roller. By varying the width of the slot above the roller, the amount of dust released can be controlled. The sets then tumble within the auger to obtain good coverage. When they reach the seed outlet drop, the treated sets can fall onto a belt conveyor.

The capacity of the treater is determined by the width of the auger and the speed at which it rotates. The speed of the auger should be adjusted so that it runs close to, but not completely, full. This should give good interaction and tumbling of the seed pieces as they move up the auger. For optimal performance, it is recommended that the auger be inclined upward.

Drum Seed Treater

The drum seed treater consists of four main parts, namely the:

- inlet chute
- rotating drum
- dust metering mechanism
- seed discharge chute.



Basic Operation

Potatoes from the set cutter are directed onto the inlet chute. Once on the chute, they slide into the upper end of the drum. Gravity moves the sets toward the lower end of the drum. At the same time, the rotating action of the drum gently tumbles them in the dust pesticide treatment. A small auger takes dust from the dust hopper to the top of the drum where the potatoes enter. The speed of the auger is controlled by a variable speed motor drive. The amount of dust released can be controlled by changing auger speed. At the bottom end, internal baffles lift the potatoes upward around the edge of the drum. As they rotate upward, the sets slide off the baffles onto the discharge chute. A belt conveyor is usually positioned below the discharge chute.

The rotational speed of the drum is constant. Capacity of a drum treater is determined by the angle that the drum is inclined. If the inlet end is raised upwards, the sets naturally slide more quickly toward the bottom of the drum. As the pitch of the barrel is increased, more sets are lifted out of the drum, increasing capacity. If you exceed the capacity of the drum treater, uniform pesticide coverage of the sets will be reduced.

Calibration of Potato Dust Treaters

The label of the treatment product will provide an application rate. This is expressed as the grams of pesticide that should be applied to each 100 kg of seed. The calibration procedure for dust treaters requires that the amount of pesticide applied to a given amount of potatoes be confirmed. The amount of dust is usually measured in terms of a bag. This section will show how to convert the label rates (grams per 100 kg of seed) into kilograms or hundredweights per product bag. Accurate measurement of the amount of seed that has been treated is required.

Most Island potato producers, if asked how many potatoes they have on a truck, will respond with the number of hundredweight (CWT). One hundredweight equals 100 pounds of potatoes. To follow a pesticide label, however, you must convert to kilograms. One kilograms equals 2.2 pounds. One hundred kilograms equals 220 pounds or 2.2 CWT.

Converting Label Rates

It is easy to calculate the amount of sets that one bag of PSPT dust will treat.

The equation to calculate the amount of potato sets that one full bag of PSPT dust will cover is:

$$\frac{\text{Size of PSPT dust bag (kg) X 100,000}}{\text{Application rate (grams per 100 kg of seed)}} = \text{kilograms of seed per bag}$$

$$\frac{\text{Size of PSPT dust bag (kg) X 2,200}}{\text{Application rate (grams per 100 kg of seed)}} = \text{CWT of seed per bag}$$

Example - A1: The amount of potato sets that one full bag of PSPT dust will cover is:

$$\frac{\text{Size of PSPT dust bag (20 kg) X 100,000}}{\text{Application rate (500 grams per 100 kg of seed)}} = \text{4,000 kilograms of seed per bag}$$

$$\frac{\text{Size of PSPT dust bag (20 kg) X 2,200}}{\text{Application rate (500 grams per 100 kg of seed)}} = \text{88 CWT of seed per bag}$$

Potato Flow Measurement

The potato flow rate refers to the volume of potatoes moved in a given period of time. The most common way of assessing a potato flow rate is to measure the time required to fill a truck bulk box. For example, over a two hour period, a grower filled a bulk box to the point where it was estimated to contain 300 CWT of potato sets. The potato flow rate would be 300 CWT ÷ 2 hours or 150 CWT per hour. However, a trip to the local scales showed that the weight of the potatoes was only 12,727 kg (280 CWT). Remember, the rated capacities of bulk boxes are not exact measurements and relying on this type of measure can lead to error.

A better form of measurement would be to use a pallet box. Pallet boxes are built to hold a specific weight of potatoes when they are filled to 'level'. Pallet boxes are manufactured to different specifications (length x width x height). Thus, they are rated for different weights such as 1000, 1200, or 1500 kg. The weight of the potato sets in the pallet box should be confirmed by scale measurement. The first step is to measure the time required to fill the pallet box. With the weight of the pallet box known, the seed flow rate can then be calculated in kilograms per minute.

Smaller containers, such as a 20-litre pail, can be used to calculate flow rate, but the sample collection time period will only be a few seconds. While this can give an initial sense of the flow rate, the short sample period can lead to error.

Potato Flow Rate Variations

Most potato seed cutting lines would appear to have a fairly constant potato flow rate based on their daily output. However, if the flow rate was measured every five minutes some variations would likely be observed. One common source of variation can come from the bulk hopper feeding the set cutter. A full hopper does not unload as fast as an almost empty hopper. Adding potatoes to the hopper more frequently will result in a more constant unloading speed.

Like snowflakes, no two potato seed cutting operations are exactly the same. Operators must assess each component in their cutting line. The goal is to minimize potato flow rate variations without reducing the quality of the seed pieces.

Calibration Test

The following test can be used to confirm label application rates for PSPT dust treaters:

1. Place one full bag of seed treatment in the hopper.
2. Carefully level the seed treatment in the hopper.
3. Mark the level line on the four sides of the hopper.
4. Add a second bag of seed treatment.
5. Operate the seed treater until the level mark in the hopper is reached.
6. Measure the volume of seed treated.
7. The measured volume of the seed treated is now “per bag”.
8. Compare your measured volume to the volume recommended on the product label.
9. Make any necessary adjustments and repeat the test.

Always wear the recommended personal protective equipment when performing these tests.

Example - A2: Calculate the kilograms of potato sets that one full bag of dust should cover.

$$\frac{\text{Size of PSPT dust bag (20 kg) X 100,000}}{\text{Application rate (500 grams per 100 kg of seed)}} = 4{,}000 \text{ kilograms of seed per bag}$$

During a test period, four and one-half (4.5) 1,000 kg pallet boxes were filled, for a total of 4,500 kilograms.

Therefore, because one bag of PSPT dust should be applied to every 4,000 kilograms of potatoes, you need to increase the dust delivery rate and retest.

Example -A3: Calculate the CWT of potato sets that one full bag of PSPT dust should cover.

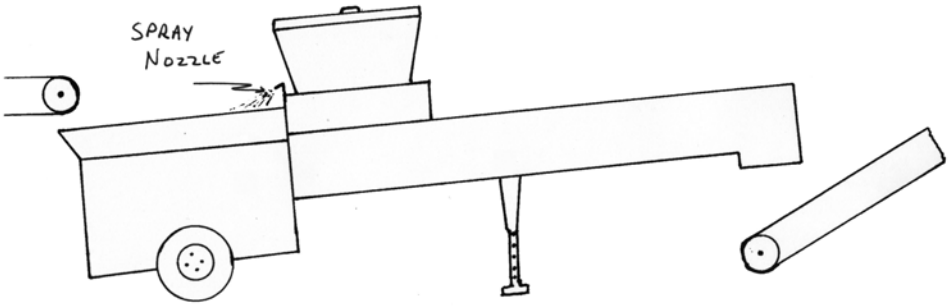
$$\frac{\text{Size of PSPT dust bag (20 kg) X 100,000}}{\text{Application rate (500 grams per 100 kg of seed)}} = 88 \text{ CWT of seed per bag}$$

It took 1.5 hours for a 250 CWT truck box to be filled. During that period, three bags of PSPT dust were used.

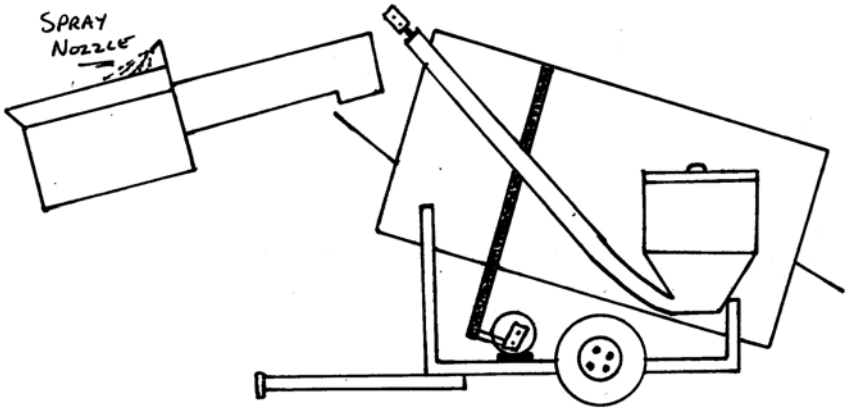
Therefore, because one bag of PSPT dust should be applied to every 88 CWT of potatoes, three bags will treat 264 CWT. Since only 250 CWT were treated, the dust delivery rate should be decreased slightly.

Application of Potato Seed Piece Treatments - Liquids

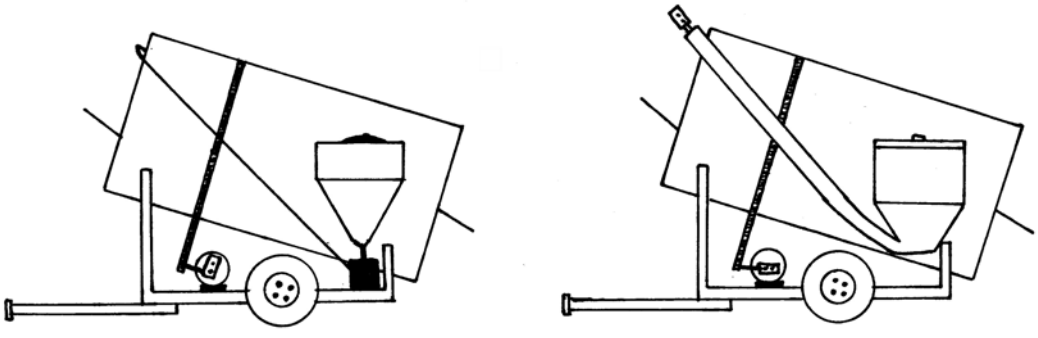
Liquid seed treatments often recommend that a PSPT dust treatment or an inert absorbent ingredient be applied after the liquid treatment. *(Various types of PSPT dust treaters were discussed earlier.)* The type of PSPT dust treater used effects how the liquid treatment will be applied. There are three possible combinations used.



Auger Duster Combined with a Stationary Sprayer



Drum Duster Combined with a Wet Auger and a Stationary Sprayer



Drum Duster Combined with a Liquid Drum Treater

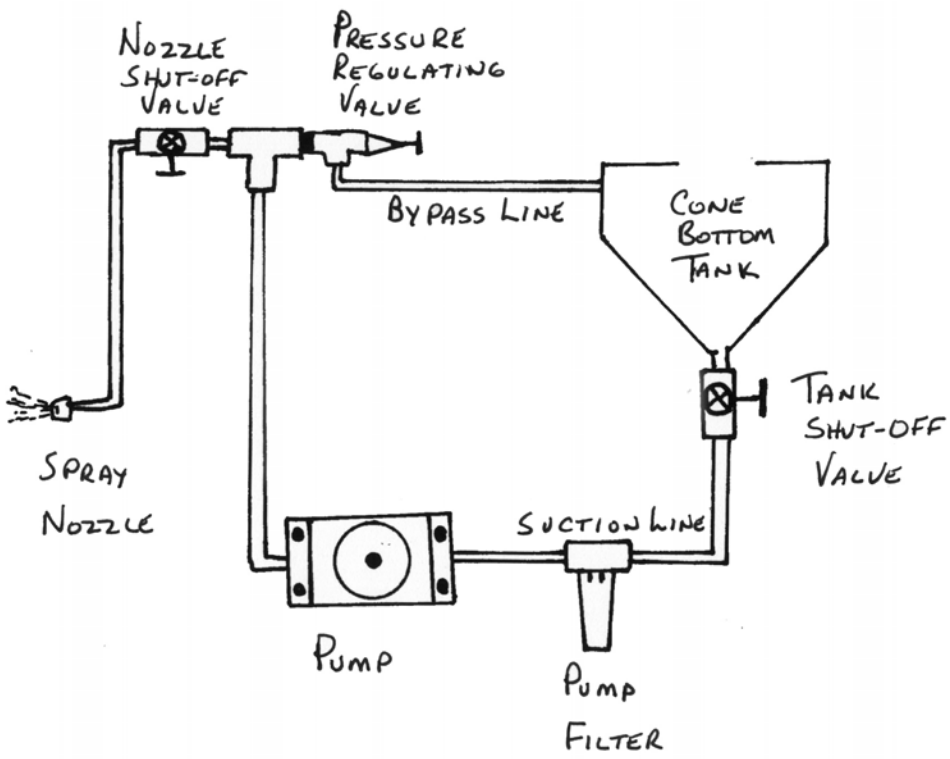
If an auger type duster is used, the liquid seed treatment can be sprayed directly into the inlet

hopper. If a drum type duster is used, the liquid seed treatment cannot be sprayed into the drum. Owners of drum treaters can apply the liquid seed treatment in a "wet" auger before the sets enter the drum. A wet auger is similar in concept to an auger duster except it does not have a dust metering mechanism. Manufacturers of drum dusters also build drum treaters specifically for the application of liquid seed treatments.

The purpose of all these systems is to spray the liquid treatment onto the potato sets. A concentrated pesticide mixture is used to minimize wetting of the potato sets. Each of these systems uses a stationary sprayer to move the liquid from the tank to the nozzle. The type of spray, the point of application, and how the treatment is distributed on the seed differs between these systems. The following section will outline how each of these systems functions.

Stationary Sprayer Components

Stationary sprayers used with liquid treaters are often assembled on-farm with either new or existing parts. The basic components of the stationary sprayer are similar to a field sprayer, but are chosen to optimize the seed treatment application. It is important to understand how each of these components must function together as a unit. The following provides an outline of the various components.



Tank

Labels of liquid seed treatments recommend very low dilution rates of the product and low application rates. This means a small amount of product will go a long way, so large-capacity tanks are not needed. A tank size of 57 litres (15 U.S. gallons) will provide enough capacity for most operations. For better pesticide mixing, polyethylene cone bottom tanks are recommended.

Agitation

When the seed treatment is a flowable formulation, the container must be shaken before it is poured into the tank. If the product settles out in the container, then it will also settle out in the tank. When cone-bottom tanks are used with properly sized pumps, a jet agitator will not be required. The cone bottom tank shape improves agitation. If other tank shapes are used, a hydraulic or mechanical agitator may be needed. To minimize product settling out overnight, mix only enough product to be used during one day.

Pump

Either a roller or diaphragm pump can be used. These pumps can be belt driven by an electric motor. Select pulley sizes to give a pump output of roughly 15 litres per minute. The nozzle used to apply the treatment requires less than 1 litre per minute of pump capacity. The bypass capacity (14 litres per minute) will be more than enough to provide adequate tank agitation. To protect the pump, a bowl-type filter should be installed between the tank and the pump.

It is generally recommended that the electric power for the motor driving the pump be supplied from the duster unit. With this approach, a single switch can turn off both the liquid treater and the duster at the same time.

Pressure/Flow Control

Stationary sprayers use a pressure regulating valve to set the nozzle pressure. Turning the handle on the regulating valve will change the pressure. Position the pressure gauge where it can be easily observed by the operator. Pressure gauges can be positioned well away from the treater with no loss of accuracy. An on/off valve on the nozzle supply line will allow the tank to be agitated in the morning without the nozzle spraying. *(Correct nozzle pressure will be addressed in the calibration section.)*

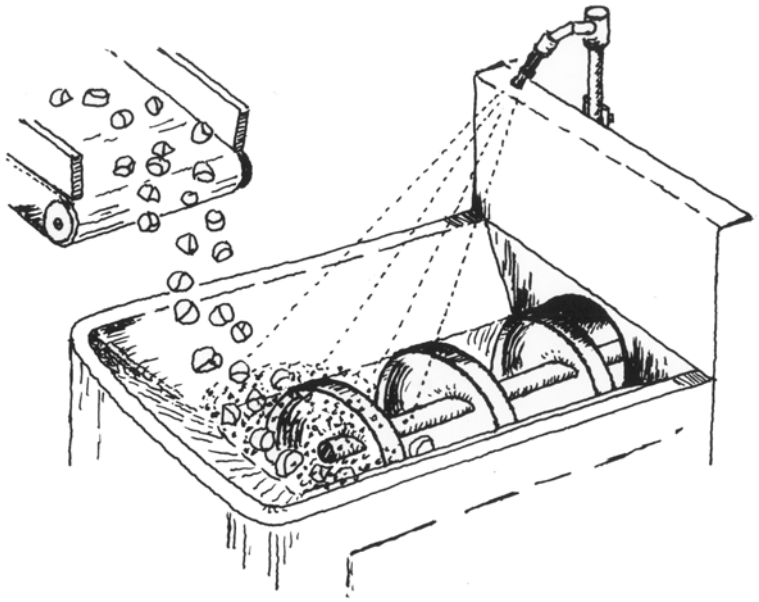
Nozzle Type

In auger type dusters, a single hollow cone nozzle is used to spray treatment into the inlet hopper. A few of the larger auger seed treaters have been set up with two hollow cone nozzles to increase the area of wetting. Colour coded ConeJet nozzles are recommended. ConeJet nozzles are rated on a per hour basis at 40 PSI. A ConeJet TX-1 nozzle will deliver one U.S. gallon per hour. A ConeJet TX-2 nozzle will deliver two U.S. gallons per hour. A mesh type nozzle filter should be installed before the nozzle. *(The size of nozzle needed will be discussed in the calibration section.)*

Due to the low dilution rate, the spray mixture is often very thick (viscous). When sprayed out of the nozzle the resulting spray pattern will not be perfectly symmetrical. This distorted spray pattern does not present a critical application problem. The role of the nozzle is to apply the correct volume and distribute it over a wide area in the inlet hopper.

Nozzle Positioning

The positioning of the nozzle in the inlet hopper will be the same on an auger type duster or a "wet" auger. As shown in the figure below, the nozzle is mounted on the inlet hopper wall so that it sprays back toward the start of the auger. Aim the nozzle toward the first couple of flights of the auger. It is impossible to spray all the sets as they fall into the hopper. By aiming the spray toward the start of the auger, the rest of the exposed auger will become wet. The majority of coverage is gained when the sets wipe against the auger flights.



Product labels for liquid potato seed treatments state that a “shielded” spray system must be used. For label compliance, you should construct a hood over the inlet hopper or the entire treater. The shield should allow you to see the nozzle and provide easy access for calibration. The shield can be constructed using a metal or wooden frame with a plastic covering.

Simply, the inlet hopper acts as a catch basin for the liquid. Most auger type PSPT dust treaters have a small hole cut into the lower end of the hopper to allow rainwater to drain out. This hole must be plugged to keep the pesticide from leaking out onto the floor. If leakage occurs around the lower auger bearing mount, install a shallow tray to catch any drips.

Liquid Drum Treater

The movement of potato sets through a liquid drum treater is the same as with the drum duster discussed earlier. Instead of having a dust metering system, however, a liquid metering system is used. Technically, the liquid metering system is similar to a stationary sprayer but is constructed with special components. The following discussion provides a list of these.

Tank and Agitator

A 114-litre (30 gallon) tank is common on drum treaters. These tanks are equipped with either a circulation pump for agitation or a mechanical agitator.

Pump

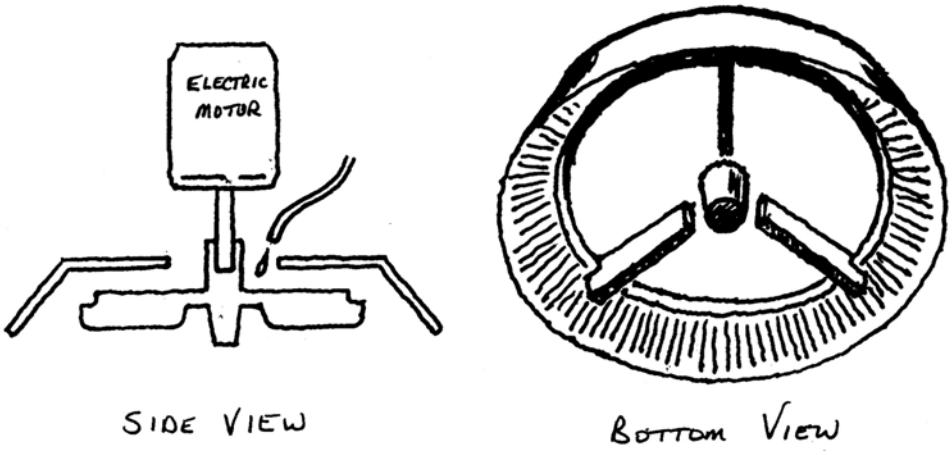
A peristaltic (hose) pump is used to supply the nozzle with pesticide mixture. The flow output of this type of pump is extremely uniform. Each rotation of the roller pinches the hose and squeezes out a fixed amount of liquid. This type of pump generates liquid flow but no pressure. This pump cannot be used with nozzles, such as the ConeJet, which use pressure to make droplets.

Controls

The hose pump is driven by a variable speed motor drive. To increase the application rate, you simply need to turn the control dial. Options such as a digital rpm readout are available.

Nozzle Type

The drum type applicator uses a spinning disc nozzle. The liquid from the pump is metered into the center of the spinning disc where it is atomized by centrifugal force. These nozzles produce a very fine droplet size. The wetting area for the nozzle is quite large and gives good coverage on the inside surface of the drum. As the potatoes slide down the inside of the drum, they wipe the liquid off the drum surface. The tumbling action further distributes the pesticide treatment on the potatoes.



Calibration of Potato Liquid Treaters

On the product label an application rate is recommended. This is always expressed as the millilitres of product that should be applied to each 100 kg of seed. This section explains how to convert the label rates (ml per 100 kg of seed) into kilograms or hundredweights per jug of product. The calibration procedure for liquid treaters requires that the amount of liquid applied to a given amount of potatoes be confirmed.

Before calibrating an operating liquid treater, the required amount of pesticide material for the estimated potato flow rate needs to be determined. This estimated flow rate is used to select the correct nozzle for treaters with a stationary sprayer or pump speed for liquid drum treaters. Once the correct nozzle or pump speed is selected, the flow must be checked during operation to confirm that the correct rate of product is being applied.

Converting Label Rates

It is easy to calculate the amount of potato sets that one container of pesticide will treat.

The equation to calculate the amount of potato sets that one full container of seed treatment will cover is:

$$\frac{\text{Size of treatment container (Litres) X 100,000}}{\text{Application rate (millilitres per 100 kg of seed)}} = \text{kilograms of seed per container}$$

$$\frac{\text{Size of treatment container (Litres) X 2,200}}{\text{Application rate (millilitres per 100 kg of seed)}} = \text{CWT of seed per container}$$

Example -B1: The amount of sets that one full container of seed treatment will cover is:

$$\frac{\text{Size of treatment container (3.785 L) X 100,000}}{\text{Application rate (39 mL per 100 kg of seed)}} = \text{9,700 kg of seed per container}$$

$$\frac{\text{Size of treatment container (3.785 L) X 2,200}}{\text{Application rate (39 mL per 100 kg of seed)}} = \text{213.5 CWT of seed per container}$$

Estimating Nozzle Flow Rate

To determine the nozzle flow rate for a specific treater, there are four factors to consider.

- the dilution rate of the formulated product
- the application rate that is selected from the label (ml per 100 kg of seed)
- the nozzle flow sample period
- the potato flow rate

Dilution Rate

The maximum dilution rate may be stated on the label. For example, one product label states "Do not dilute with any more that 3 parts water to 1 part product". To avoid having to measure liquid treatment, as much as possible mix full containers. Mixing can be made easier by using a large water container, thus allowing for a single measurement. For example, to prepare a 3 parts water to 1 part product mixture, mark the liquid level in an unopened jug. Pour the jug into the treater tank. Fill the container with water to the mark you made. Pour that water into a five-gallon (20 litre) bucket. Add two more "marked" jugs of water. In the five-gallon bucket, you will have a total of three jugs of water. Mark the level of the water on the inside of the large bucket. When additional product needs to be added to the tank, merely add one jug of product and one marked bucket of water. No counting to three is needed, and there is no chance of a mixing error. Do not prepare more mixture than can be used during that day.

Application Rate

The product label can recommend a range of application rates. The rate that should be used depends upon several factors, such as potato variety and length of control required. Crop specialists can assist you in determining the best application rate for your situation.

Nozzle Flow Sample Period

During operation, a thin film of the spray mixture will form on the auger flights or on the inside of the drum. When the nozzle flow is being sampled, the potatoes going through the treater will be treated by wiping off the thin film. For potato flow rates of less than 200 CWT per hour, a flow sample period of 10 seconds is the industry norm. For higher potato flow rates, the flow sample period is reduced to 5 seconds.

Potato Flow Rate

The measurement of potato flow rate for liquid treaters is the same as dust treaters. Refer to material presented in the section titled *Application of Potato Seed Piece Treatments - Dusts* to review methods of measuring potato flow rate.

The following equation can be used to estimate the required nozzle flow rate for your operation. To use this equation, you will need to determine the dilution rate, the application rate, potato flow rate, and nozzle flow sample period.

The following formula can be used to calculate the nozzle flow rate (in millilitres of pesticide that must be delivered in the sample period):

Total Number of Dilution Parts (X parts water + 1 part product) ***multiplied by***
Label application rate (ml per 100 kg) ***multiplied by***
Potato Flow Rate (CWT per hour) ***multiplied by***
Nozzle Flow Sample Period (seconds) ***divided by***
Conversion Constant (7920) ***equals*** ml per sample period

Example -B2: Calculate the millilitres of pesticide that must be delivered in a sample period.

Step 1: Fill in the numbers for your operation.

For this example, lets assume that the potato sets are cut at 175 CWT per hour, the product is diluted with 3 parts water, and the application rate is 26 ml per 100 kg of sets.

Total Number of Dilution Parts (3 parts water + 1 part product) = 4 parts
Label application rate = 26 ml per 100 kg
Potato Flow Rate = 175 CWT per hour
Nozzle Flow Sample Period = 10 seconds
Conversion Constant = 7920

Step 2: The equation can now be used.

Compute: 4 **x** 175 **x** 26 **x** 10 ÷ 7920 = 23 ml per 10 seconds

The nozzle flow rate is 23 ml in a 10 second period.

Nozzle Selection

Stationary sprayers use a nozzle to make droplets. The correct nozzle must deliver the right amount of liquid at a suitable pressure. In the previous example, a nozzle flow rate of 23 ml in a 10 second period was required. The following chart shows the flow rates for ConeJet nozzles for a variety of pressures.

Nozzle Cone-Jet	Nozzle Colour	Mesh Size	Rate Nozzle Flow - Millilters Per 10 Seconds						
			20 PSI	25 PSI	30 PSI	35 PSI	40 PSI	45 PSI	50 PSI
White	TX - 2	100	15.2	17.0	18.6	20.1	21.5	22.8	24.1
Yellow	TX - 3	50	22.8	25.5	28.0	30.2	32.3	34.3	36.1
Green	TX - 4	50	30.4	34.0	37.3	40.3	43.1	45.7	48.1

From the chart, a White TX-2 delivers 23 millilitres per minute at 45 PSI. The larger Yellow TX-3 nozzle delivers 23 millilitres per minute at 20 PSI. Selecting the larger nozzle, operated at lower pressure, will result in courser spray droplets. The operating pressure should be kept between 20 and 50 PSI.

Flow Verification

The confirmation of the nozzle flow rate needs to be repeated many times throughout the day when using a stationary sprayer. The hose-type pumps used on liquid drum treaters do run quite steadily, but they should also be checked regularly.

To measure the nozzle flow rate you will need a small 100 ml-graduated cylinder and a watch that measures seconds. Hold the graduated cylinder under the nozzle to collect the spray from the nozzle. Collect the spray for the length of the sample period. After taking the sample, add a drop of anti-foam into the graduated cylinder and gently shake the cylinder. This removes any air bubbles in the sample and gives a more accurate reading.

If the quantity measured is below that required, increase the pressure on stationary sprayers or the pump speed on drum treaters and repeat the test. If the pressure increase results in pressures greater than 50 PSI, install a bigger nozzle and lower the pressure.

Case Study - Importance of Flow Verification

A farm has a set cutter that cuts at the rate of 120 CWT per hour. Let's assume that for 20 minutes the ConeJet nozzle partially plugs and the nozzle flow rate drops by 75 percent. The level of pest control provided for these sets will be reduced. Over that 20-minute period, roughly 40 CWT of sets would have been cut. This translates into 0.8 to 1.6 hectares (2 to 4 acres) of crop, depending upon the variety. The problem is compounded each time the seed is handled. For example, when it is loaded into the truck and unloaded to the planter, the under-treated seed will be mixed with the other sets. Therefore, as the plants grow, the problem will not be restricted to just a corner of one field but could be scattered over two or more fields. If the field has to be sprayed with another pesticide to provide adequate pest control, the cost of the mistake can be significant. It is this possibility that justifies the need to continually confirm that the correct amount of pesticide spray is being delivered.

Applying Liquid Formulations on Cereals

The most common cereal grain seed treatments are liquid based, flowable formulations. Most cereal grain treatments are applied without mixing. However, always check the product label before using these as some can require dilution with water. The 'on-farm' application of cereal treatments is very limited. Most cereal seed treatments are done in conjunction with commercial grain cleaning, certified grain sales, and specialty services offered to cereal producers.

The main objectives for applying a cereal seed treatment are the same as for a potato seed treatment. The first objective is to apply the correct amount of pesticide. The cereal treater must be able to deliver the correct amount of seed treatment on a constant basis. Easy adjustment of the product flow rate is necessary to correct for slight variations of seed flow rate. The second objective is to keep the seed flow rate through the treater as uniform as possible. Grain augers can provide a fairly constant flow rate as long as the supply of seed to them is steady. The third objective is to get good coverage of the product on the surface of the seed. A standard transport grain auger will provide a reasonable level of mixing and surface coverage. Augers can be modified with special flights to improve mixing and surface coverage. The number of points where the pesticide treatment is fed into the auger can also be increased to improve coverage.

There are three main types of equipment used to apply liquid pesticide treatments to cereal grains, namely:

- a grain auger with a gravity flow system
- a grain auger with a stationary sprayer
- a proportional flow metering seed treater.

Gravity Flow System

Gravity flow systems are the simplest type of liquid cereal treater equipment. The system consists of a tank with a hole in the bottom that allows the pesticide treatment to drain by gravity into the mixing auger. A valve can be installed on the feed hose to the auger, to regulate treatment flow. Temperature changes will alter the viscosity and in turn, product flow rate. The container should be marked in litres so that the amount of pesticide being applied can be measured. It takes an experienced operator to do a 'reasonably' good job of uniformly applying the treatment.

Stationary Sprayer System

The stationary sprayer systems used on cereal treaters are similar to those used on liquid treaters for potatoes. For these systems, a nozzle is mounted so as to spray inside the auger casing. If the stationary sprayer uses a hose type pump, an auger connection similar to that of gravity flow systems is used. With stationary sprayer systems, the nozzle flow rate can be closely monitored and easily adjusted. The ability of the auger used to provide enough mixing action will determine the degree of coverage obtained.

Proportional Flow Metering System

This type of grain treating system is typically used by commercial seed treaters. The seed is first augered into a tilting dump pan. When the pan reaches a preset weight it tilts to one side and dumps the seed. Through a mechanical linkage, the dumping of the pan also results in the dumping of a cup of seed treatment. Thus, the treatment application is proportional to the flow rate of the grain. With these systems, variations in the seed flow rate do not affect the application rate. A number of equipment manufacturers offer variations of the proportional metering system. There are also variations in the design of the mixing component of the treater. If operated properly, these systems do a very good job of applying cereal seed treatments.

Calibration of Cereal Seed Treaters

Pesticide product labels will provide an application rate. This is always expressed as the millilitres of product that should be applied to each 100 kg of seed. The application rate is dependent on the type of seed treated and the potential pests. This section explains how to convert the label rates (ml per 100 kg of seed) into kilograms per product container. The calibration procedure for liquid treaters requires that the amount of liquid applied to a given amount of cereal seed be checked.

Converting Label Rates

It is easy to calculate the amount of cereal seed that one container will treat.

The equation to calculate the amount of cereal seed that one full container of seed treatment will cover is:

$$\frac{\text{Size of treatment container (Litres) X 100,000}}{\text{Application rate (millilitres per 100 kg of seed)}} = \text{kilograms of seed per container}$$

Example -C1: The amount of cereal seed that one full container of seed treatment will cover is:

$$\frac{\text{Size of treatment container (10 L) X 100,000}}{\text{Application rate (285 mL per 100 kg of seed)}} = 3{,}509 \text{ kg of seed per container}$$

Cereal Flow Measurement

In contrast to potatoes, the movement of cereal seed is much more uniform. The physical characteristics of cereal seeds, such as their small uniform size and smooth surface, allow them to flow easily. Combined with properly maintained augers, the seed flow rate can be quite steady.

The characteristics that allow for easy cereal flow also make it easy to measure a seed flow rate. The first step is to measure the time required to fill a container. The container should be large enough to allow a collection time period of not less than 30 seconds. The larger the container used to measure, the more accurate the reading. The second step is to measure the weight of the seed collected in the container. Calculate the seed flow rate by dividing the collected weight by the collection time.

Calibration Test

The calibration procedure for cereal seed treaters compares the actual volume of liquid applied to a volume of seed with the label requirement.

The following test can be used to confirm label application rates for liquid cereal treaters:

1. Partially fill the treater tank with liquid seed treatment.
2. Mark the liquid level on the inside of the tank.
3. Add a carefully measured amount of seed treatment to the tank.
4. Operate the seed treater until the level mark in the hopper is reached, measuring the time.
5. Measure the volume of seed treated.
6. Compare the measured volume to the volume recommended on the label.
7. Make any necessary adjustments and repeat the test.

Always wear the proper personal protective equipment when performing these tests.

Example - C2: Calculate the kilograms of cereal seed that one litre of seed treatment should cover.

For this example, let's assume that a carefully measured one litre amount of pesticide is added to the tank.
It takes 6 minutes for the level in the tank to drop to the mark.
A bucket held under the auger outlet took 20 seconds to fill.
The measured weight of cereal in the bucket was 22 kg.

Label Rate:

$$\frac{\text{Size of Treatment Measure (1 litre) X 100,000}}{\text{Application rate (285 ml per 100 kg of seed)}} = 351 \text{ kilograms of seed per 1 litre}$$

Treatment Rate:
The seed flow rate is 22 kg in 20 seconds.
This equals 66 kg per minute.
It took 6 minutes to apply 1 litre of treatment.
In that 6 minute period (66 kg/minute X 6 minutes), 396 kg of seed were treated.

Therefore, because one litre of treatment should be applied to every 351 kilograms of seed, you need to increase the treatment delivery rate or decrease the seed flow rate and retest.

Seed Treatment – Health and Safety

Individuals Handling Seed Treatments

Always read the product label before handling any seed treatment. The *Precautions* section of the product label will indicate:

- the personal protective equipment that you must use, and
- the type and potential of personal risk associated with product use.

When handling seed and seed piece treatment pesticides, most product labels require that you cover your legs and arms, and wear chemical-resistant gloves, goggles/face shield, and a dust mask. Some product labels call for additional protection, such as the use of a NIOSH-approved respirator. ALWAYS read the label for each pesticide that you apply and follow all label instructions.

When applying a dust treatment, a number of safety issues must be considered. With dusts or fine sprays, inhalation exposure can occur. When you breathe in dust particles, they are absorbed by your lungs. Remember, at the end of the day you cannot wash off pesticide contaminants that are already inside your body.

All of the commonly used potato dust treatments recommend that you wear a dust mask or state that you should avoid inhalation of the dust. When emptying a bag of seed treatment pesticide into a hopper, it is virtually impossible to do it 'dust free'. To avoid breathing in the pesticide, you MUST wear a dust mask when filling the hopper. When the dust treatment contains an insecticide, the label will typically require that you to wear a NIOSH-approved respirator.

The application of seed treatment pesticides is generally not a one-person job. In potato operations, a work crew is present to improve the quality of the cut seed. In cereal operations, treated seed is often bagged for sale or shipment. Regardless of the situation, all individuals in the treatment area must be protected from possible exposure. Restrict nearby workers to those people essential to the treatment activity itself.

Dust Treatments on Potato Sets

Most potato seed treatments are applied inside a building. When working inside a building, good air quality must be maintained. Some product labels state that you must apply the pesticide in a 'well-ventilated area'. In a well-ventilated area there should be no visible dust in the air and minimal pesticide-related smell. A well-ventilated area protects the safety of everyone within the area.

After the potato has been cut, the sets are ready to be treated. Often the treater is positioned immediately following the set cutter. The desire to place it nearby is understandable, as it makes it easy to service, monitor, and adjust. However, protecting your health and the health of co-workers must be your most important consideration. Potential exposure to seed treatments can be reduced by locating the treatment equipment further away from the set cutter. Installing a conveyer belt between the set cutter and the treater will provide a safety buffer for workers on the set cutter.

The level of worker protection can also be increased by installing dust containment structures around the treatment equipment. The containment structure will help to limit the movement of air. When the hopper is filled with pesticide and dust is released to the air, it settles within the structure and does not move throughout the entire building. Containment structures can be a tent type enclosure, a simple wooden stud frame with a poly coating, or a separate room with solid walls.

The use of exhaust fans will also greatly improve ventilation. The fans should be positioned to pull dust-filled air out of the building. The effectiveness of exhaust fans is increased when they are used in combination with a containment structure.

Liquid Treatments on Potato Sets

Liquid pesticide drift can also pose a risk to human health. Liquid potato seed treatment labels require that a shielded spray system be used. A shielded system will contain possible product drift and prevent the loss of any liquid. Most often, the liquid application is followed by a dust application. For this reason, these treatments often share components and are typically located together. The recommendations outlined for reducing worker exposure to dust treatments can also address exposure issues related to the use of liquid treatments.

Liquid Treatments on Cereal Seed

When applying a liquid seed treatment on cereals, always wear protective body clothing, gloves, goggles, and a dust mask or appropriate respirator. Even though a liquid formulation is being used, handling treated seed is usually a dusty job. The use of an exhaust fan can improve air quality within the treatment building. The personal protective equipment recommended for applying a liquid treatment to cereals is also recommended for handling the treated seed.

Good Work Site Practices

The safe use of seed treatment also involves maintaining good work site practices. These include:

- Keep all work sites clean and tidy.
- If a seed treatment product is spilled, clean it up immediately. Check the label for specific instructions on decontamination procedures. Always wear the appropriate personal safety equipment.
- Dispose of empty pesticide containers in the manner recommended by provincial authorities.
- Ensure that all protective shielding on the equipment is properly installed. Lubricate the equipment at the intervals recommended by the manufacturer.
- At the end of the treatment season, wash and lubricate the application equipment before storing it. Wash seed treaters well away from watercourses and wells. Check the label for required buffer zones around watercourses and wells. After washing, winterize liquid treaters by adding environmentally safe antifreeze.