SEED TREATMENT

PESTICIDE APPLICATION
AND
SAFETY TRAINING
STUDY GUIDE

UTAH DEPARTMENT OF AGRICULTURE

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SEED TREATMENT STUDY GUIDE

The educational material in this study guide is practical information to prepare you to meet the written test requirements. It doesn't include all the things you need to know about your pest-control profession. It will, however, help you prepare for your examinations.

Contributors include the Utah Department of Agriculture and Utah State University Extension Service. This study guide is based on a similar one published by the Colorado Department of Agriculture. Materials were prepared by Colorado State University Extension Service. Other contributors include: University Extension Service personnel of California, Kansas, New York, Oregon, Pacific Northwest, Pennsylvania and Wyoming; U.S. Department of Agriculture - Forest Service; the U.S. Environmental Protection Agency (EPA), Office of Pesticide Programs; and the Department of Interior - Bureau of Reclamation and Metro Pest Management.

The information and recommendations contained in this study guide are based on data believed to be correct. However, no endorsement, guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

Additional topics that may be covered in your examinations include First Aid, Personal Protective Equipment (PPE), Protecting the Environment, Pesticide Movement, Groundwater, Endangered Species, Application Methods and Equipment, Equipment Calibration, Insecticide Use, Application, Area Measurements, and Weights and Measures. Information on these topics can be found in the following books:

1. **National Pesticide Applicator Certification Core Manual,** Published by the National Association of State Departments of Agriculture Research Foundation.

2. **The Workers Protection Standard for Agricultural Pesticides – How to Comply: What Employers Need to Know.** U.S. EPA, Revised September 2005, Publication EPA/735-B-05-002.

These books can be obtained from the Utah Department of Agriculture or Utah State University Extension Service. Please contact your local Utah Department of Agriculture field representative or Utah State University extension agent.

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INTRODUCTION

Seed treatment referred to in this study guide is the application to seed of any substance or mixture of substances intended to control diseases and insects. It includes control both while the seed is in storage and when it's in the soil after planting.

A person treating seed should not only know the kinds of seeds to be treated but also the diseases and insects to be controlled. They should also know which chemical products are effective and approved, and the chemical products their equipment can apply correctly.

Specific information should be obtained from the local extension agent, the equipment manufacturer, or the formulator of the pesticides.

DISEASE PESTS IN SEED

FUNGI AND BACTERIA

None of these disease organisms, except some smuts, need to be identified by applicators because there are some seed-surface disinfectant fungicides that control all seed rot and seedling-blight fungi and bacteria. Control of some smuts requires a specific fungicide that penetrates the seed as it begins to germinate and kills infection inside the seed, such as the loose smut of wheat and the brown loose smut of barley.

In barley stripe on the leaves, fungi are controlled by a specific seed treatment. Use only materials registered for control of the specific diseases. If smut or barley stripe is present in a field, the seed will require treatment to produce acceptable smut- or stripe-free grain in the next crop.

The following disease organisms may be found on or in seed.

Stored-grain pests and smuts:

- Alternaria
- Aspergillus
- Bacteria
- Cladosporium
- Curvularia
- Epicoccum
- Mucor
- Penicillium
- Rhizopus
- Sphaceloteca (smut)
- Tilletia (smut)
- Ustilago (smut)

Seed rots and seedling blights in soil:

- Diplodia
- Fusarium
- Helminthosporium
- Pythium
- Rhizoctonia

COMMONLY TREATED SEED DISEASES

Seed treatment with chemicals to control seed-borne and soil pests of small grains is a long-established, successful farming practice. Smuts and seedling-blight diseases can be reduced or eliminated by using effective fungicides.

WHEAT, OATS, BARLEY AND SORGHYM

Seed rots and seedling blights are caused by several seed and soil fungi. They attack germinating seeds and seedlings, especially if the seed is of poor quality and germination conditions are not ideal. Seed treatment protects young seedlings from attack and results in stronger plants and a more even stand.

Bunt (covered or stinking smut) of wheat and barley and black loose smut of barley are carried only on the seed surface. Control requires a seed-treatment seed-surface disinfectant.

Loose smut of wheat and bran loose smuts of barley infect the embryo and require systemic seed treatments (carboxin) for control. Barley loose smuts are very hard to detect, so systemic-fungicide seed treatment is advisable if loose smut was prevalent in the seed field. Barley-stripe fungus is also seed-borne and is controlled more effectively by systemic fungicides.

These problems make it more important to treat barley seed with systemic fungicide than any other small grains. Control requires a seed-treatment disinfectant that penetrates sprouting germs.

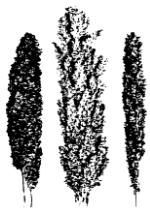
BARLEY SMUT

Covered and black smut requires a seed-treatment fungicide that penetrates into all cracks and crevices of the seed. Brown smut requires one that penetrates and disinfects sprouting germs.

Oats are affected by two smuts. Both are carried on the seed surface, but some spores may lodge under the hulls, making control difficult. With resistance in most current oat varieties, the non-systemic, surface-acting fungicides will give adequate control. Systemic, surface acting fungicides will give adequate control. Systemic materials (carboxin) may be advisable where better control is desired, such as in certified seed where smut was observed in the seed field.

SORGHUM-KERNEL SMUT

This smut is controlled by treating the surface of seeds. A smutted kernel has dark brown spores completely throughout, in contrast to saprophyte molds, which attack the surface of kernels in the field. These saprophytes don't reach all the way through the large kernels, leaving kernels white inside.



BARLEY-STRIPE DISEASE

This is controlled by a seed-treatment fungicide that penetrates into all cracks and crevices of the kernels.

HEAD SMUT OF SORGHUM

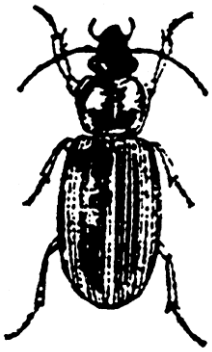
This isn't completely controlled by seed treatment, since the fungus lives in the soil and can invade seedlings below ground. Spores can be carried by the wind.

INSECT PESTS IN SEED

SOIL INSECTS

Insects that eat seed in the soil can only be controlled by treating the soil with a proper insecticide or treating the seed. Treating the seed is less expensive and puts less chemical in the soil. The following are some of the common soil insects.

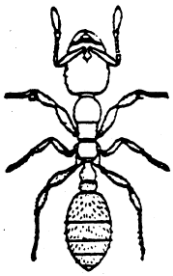
SEED-CORN BEETLES feed on corn or sorghum in



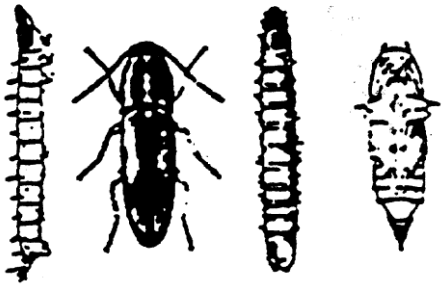
the ground. A yellowish-brown beetle with black wing covers, it measures five-sixteenths inch in length, or a little less. The head is black, while antennae and legs are light brown. There are shallow furrows on the wing covers.

SEED-CORN MAGGOT is a small black or grayish-black fly one-eighth to one-fifth inch long. The pale or yellowish-white maggots of this fly attack germinating seeds and sprouts in cold, wet seasons.

KAFIR OR THIEF ANT is a tiny, reddish-brown ant that attacks seed of sorghum or corn, resulting in a weak, sickly sprout. The starchy part of the kernel is eaten out and scattered through the ground.



TRUE WIREWORM larvae are similar to false wireworm in that they eat seeds and young plants. They

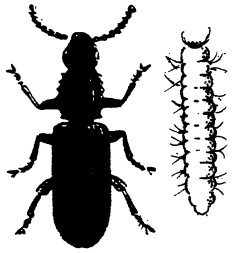


are usually found in moist soil, unlike false wireworm.

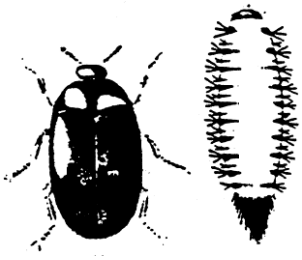
STORAGE INSECTS

Storage insects are those that damage seed when stored in bulk or in bags. The following are examples with descriptions. Some others are pea-bean weevils, and spider beetles.

SAW-TOOTHED GRAIN BEETLE is a small, slender brown beetle. There are six saw-toothed projections on the thorax, from which this pest gets its name. This beetle attacks a variety of flour, meal, fruit, candy and grains. Eggs are laid in the food. The life cycle takes three to four weeks for completion.

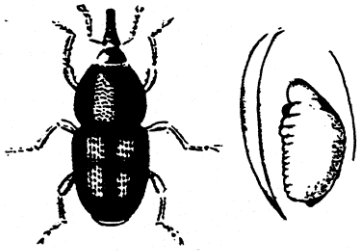


DERMESTID BEETLES, LARGE CABINET BEETLE, AND OTHER SPECIES are scavengers on animal matter such as hides, furs and wool. They will also feed on stored grain and grain products. The larvae and pupae can survive rigorous environmental conditions. Under such conditions, the life cycle may be

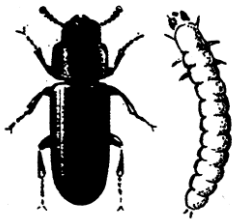


as long as two or three years.

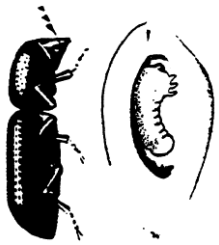
GRANARY AND RICE WEEVILS are the most common insects found infesting stored grain. Females lay their eggs in a hole cut in the intact kernel. Larvae hatch and feed inside the kernel, hollowing it out as they develop. Adults feed on whole or broken grain. A life cycle requires about four weeks for completion. Rice weevil adults fly. Granary weevil adults cannot fly.



CONFUSED FLOUR BEETLE AND RED FLOUR BEETLE larvae and adults prefer to feed on cracked grains, flour, and other cereal products. Eggs are laid loosely in the food material, and development takes place in the food. The life cycle takes about six weeks to complete.

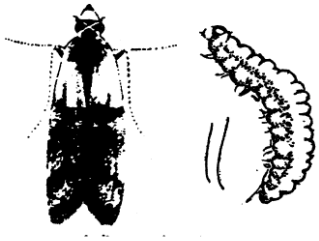


LESSER GRAIN BORER larvae are internal feeders on grain kernels. Eggs are laid outside the kernels; larvae hatch and bore into the kernels, hollowing them out as they grow. Adults can feed on whole and cracked grain.



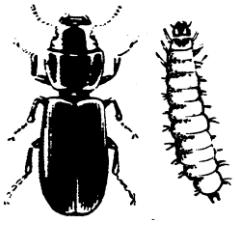
The life cycle takes three to four weeks to complete.

INDIAN-MEAL MOTH larvae feed on grains, grain products, nuts, dried fruit, and other food. The adults are colored a characteristic coppery-brown on the wings. Eggs are laid singly or in groups on the food. The life

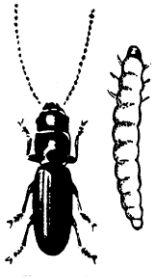


cycle takes from six to eight weeks to complete.

CADELLE is one of the largest stored-grain insects. It is primarily a wood-boring insect but will also feed on whole grain, flour or meal. Both adults and larvae can survive without food for long periods of time, hidden in the woodwork of bins. When new grain is put in the bin, the insects then move into the grain. The life cycle may vary from a few months to two years, depending on conditions.

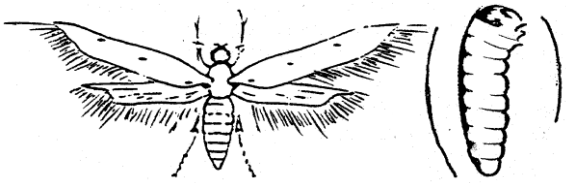


FLAT GRAIN BEETLE is one of the smallest grain-infesting beetles. Since it cannot feed on sound grain, it usually follows the attack of other insects. Under favorable conditions, the life cycle may require about five



weeks.

ANGOUMOIS GRAIN MOTH LARVAE are internal feeders on grain kernels. Females lay their eggs on the outside of the kernel, then the larvae bore in and develop inside the kernels. Beside the feeding damage, adults cover the inside of the bin and the surface of the grain with webbing.



Some of these stored grain insects are also **KITCHEN PESTS.**

The saw-toothed grain beetle, red flour beetle, larger cabinet beetle, and Indian-meal moth develop in flour, cake mixes, corn meal, breakfast foods, and similar products. The Angoumois grain moth infests popcorn.

SEED-TREATMENT PEST CONTROL

Disease- and insect-control seed treatments function in four ways, depending on the nature and purpose of the treatment.

1. **SEED-SURFACE Disinfection** -- Complete covering of the seed with a chemical that kills the spores and other forms of pathogenic organisms on the surface of the seed. Example: Killing stinking-smut spores or damping-off fungi that are on the seed.

2. **SEED PROTECTION** -- When a chemical on the seed protects the seed and young seedlings from pathogenic organisms or insects in the soil. Example: Control of seed-corn beetle or seed-rot and damping-off organisms.

3. **SEED DISINFECTION** -- Putting a chemical on the seed that penetrates into the seed, killing internal fungus growth or insects, besides killing organisms on the surface of the seeds. Example: Killing loose-smut fungus inside wheat seed or bean weevils inside the seed.

4. **SYSTEMIC ACTION** -- When a chemical on the seed penetrates the seed and extends into the plant as it grows, repelling or killing certain types of fungi or insects or preventing their feeding. Example: A systematic wheat-seed-treatment fungicide to control loose smut on wheat.

STORAGE INSECTS AND FUNGI

Most insects start to feed in sorted seed when temperatures are above 50 degrees F. and humidity is above 12 percent. However, some seed processors dry the seed to as low as eight percent. Since moisture content might increase in storage, it's a good practice to apply an insecticide. Low-level, non-hazardous materials are used.

An insecticide that becomes non-toxic is usually applied so that any leftover seed can eventually be used for food and feed. Other insecticides are applied near planting time to some seeds to keep soil insects from eating the seed. No fungicides are registered by EPA for control of fungi in stored seed.

SOIL INSECTS AND FUNGI

Seed treatment with a pesticide is necessary to control some diseases and insects in the soil that are not controlled by resistant varieties or by biological, cultural, physical or sanitary means. It is a preventative method and is recommended on kinds of seeds and in situations where research and experience in past years has shown it to be practical.

A pest may be a problem over the entire state, or it may be a problem in only some areas within a state. It may not be necessary to treat for each given problem in all localities. For example, some extension entomologists don't recommend treating wheat seed every year with an insecticide for soil insects. They know, from surveys, the areas where there are enough false wireworm beetles to produce sufficient larvae and where the soil is dry enough to cause a problem. The Extension Service can notify growers whether or not to treat; however, true wireworm population distributions are not known and may require treatment every year in nearly every location where seed is planted.

In contrast, damage to wheat seed from fungi on the seed and in the soil can't be predicted, and there is a reduction in seedling emergence of about ten percent or more in nearly all years when the seed isn't treated. Also, microscopic bunts or stinking-smut spores may be on the seed without being seen. Since yields are increased by one to three bushels per acre from seed-rot and seedling-blight control, and because the cost for proper seed treatment is relatively inexpensive, it's recommended as a routine practice for each wheat crop.

Likewise, stands of plants are often doubled and plants are more vigorous when sorghum seed is treated with a fungicide. This has produced, on the average, at least ten bushels per acre more grain and 33 percent more forage. Entomologists recommend that all sorghum seed be treated with an insecticide just before planting to prevent seed- corn beetles, wireworms, or thief ants from eating planted seed. This problem isn't as easy to predict as false wireworm damage to wheat. The cost is only a few cents per acre, so it's recommended that all sorghum seed be treated with both a fungicide and an insecticide. Seed treatment to prevent seed rots and seedling blight increases the yields of barley and oats an average of one to three bushels per acre and corn by seven bushels per acre. There would be large losses in vegetables and flowers from seed and soul fungi and insects without seed treatment. Less than half of the varieties of cereal grain used today are highly resistant to smuts. Seed treatment is necessary to keep these diseases at a non-destructive level.

APPLICATION

Mix the seed-treatment chemicals with seed thoroughly so every kernel is treated. None of the chemicals now approved are very volatile, so thorough mixing is especially important. Custom treatments should give better results than farm applications, especially if seed is cleaned and treated. However, drill-box applications are satisfactory if done carefully. Rates in the table are those given on labels and are usually at the bare minimum to be effective.

No really new chemicals have come into small-grain seed treatment usage for ten years. The "new" labels are different combinations and rates. Many companies have reduced label rates to be competitive, and this has resulted in poor control where disease conditions are moderate to severe.

The minimum effective rates of many fungicides for adequate disease control in wheat have been fairly well established. The rates of active ingredients for adequate control under moderate disease pressures are general guidelines. This will vary some with disease pressure from the weather and host susceptibility, but rates lower than these won't give satisfactory control in severe situations.

Minimum rates of common seed-treatment fungicides for adequate control.

Rate in oz./bu. of active ingredient

Chemical	Stand Increase	Bunt	Loose Smut
Captan	0.5	1.5	-
Maneb	0.5	1.0	-
Thiram	1.0	1.0	-
HCB	-	0.2	-
PCNB	-	0.4	-
Carboxin	0.5	1.0	0.3

Blanks mean either insufficient testing, not effective, or not labeled.

The amount of active ingredient per bushel of seed-treatment chemical can be calculated as follows for comparing rates:

1. If rates on labels are in ounces per bushel; active ingredients in oz./bu. can be calculated.

Multiply:

% active ingredient X oz./bu. of chemical = oz. of active ingredient/bu.

Example: Captan 75% at 0.67 oz./bu. on wheat.

0.75 X 0.67 = 0.5 oz./bu. active captan.

2. If rates on the label are in ounces per hundred weights, oz./bu. active ingredients can be calculated.

Multiply:

$$\frac{\text{\% active ingredients X oz/cwt X weight of 1 bu. in pounds*}}{100}$$

= oz. active ingredient/bu.

Example; Vitavax 25 DB at 4.0 oz./cwt. on wheat.

$$0.25 \times 4.0 \times \frac{60}{100} = 0.6 \text{ oz. carboxin/bu.}$$

* Weights in lb./bu.: wheat, 60; barley, 48; oats, 32.

Most fluid or flowable seed treatments are heavier than water. Pesticide liquids are a little heavier than water, so liquid fluid-ounces will weigh more than an ounce by weight. Therefore, to be more precise, this weight difference must be considered, but this difference usually won't be more than ten to 15 percent.

Fungicides are less toxic than the "old mercuries," but they are still poisonous and should be handled with due precautions. DO NOT FEED TREATED SEED TO LIVESTOCK. DO NOT MIX TREATED SEED WITH MARKET GRAIN.

Don't buy more than you will use. If you have some seed left over, keep it to plant next year.

Sorghum

Seed-treatment fungicides are available that effectively control kernel smut, seed rot, and seedling blight of sorghum. The fungus that causes head smut of sorghum

isn't controlled by seed treatment, as it infects the seedling above the seed.

Fungicide seed treatment has increased the yield of sorghum grain an average of more than ten bushels per acre and forage by more than 30 percent by controlling seed rots and seedling blights. A proper insecticide should be on the seed during storage. An insecticide and fungicide which are effective against soil insects should be applied before planting.

Corn

The smut of corn isn't controlled by seed treatment, because the spores are blown from the soil to any part of the plant and infect at a puncture or injury site.

Corn seed can be treated to protect against storage insects. It should also be treated with a fungicide to protect from seed rots and seedling blight of the soil. An insecticide can be applied to the soil to protect against seed-eating insects.

Sugar Beets

Both insecticides and fungicides are applied to vegetables and seeds to control storage insects and to control seed rots and seedling blights in the soil.

Sometimes tomato, crucifer, and eggplant seeds are hot-water-soak-treated to remove certain bacteria and fungus agents.

Compatibility

Most fungicides and insecticides registered for seed treatment are compatible when mixed. One should consult the label on each product for such information. A small slurry mixture of the materials should be made to test compatibility before the actual mixing and treating operation begins.

PESTICIDE LABELS

Before using any pesticide, study and analyze the information on the label. The label contains detailed information about the product, including:

l. Active ingredients
2. Inert ingredients
3. Warning statements, such as "Danger -- Keep Out of Reach of Children" or "Poison -- Handle with Care"
4. Antidotes
5. Type of seed and treatment rate
6. Kinds of pests controlled
7. Care in handling and use of treated seed
8. Disclaimer of warranty clause
9. Mixing instructions
10. Compatibility remarks

Labeling Treated Seed

There are federal and state seed laws for labeling treated seed. Information required to be shown on the label includes:

1. A word or statement in no smaller than eight-point type indicating that the seed has been treated.

2. The commonly accepted, chemical or abbreviated chemical (generic) name of the applied substance and rate of application.

3. Seed treated with a restricted-use toxic substance will be labeled to show a statement such as "poison treated" in red. In addition, the label will show a skull and crossbones.

   Sample label for restricted-use, highly toxic substances:

   THIS SEED TREATED WITH POISON.
   Treatment Used: Phorate

5. Seed treated with a general-use or low-toxicity substance, if the amount remaining with the seed is harmful to humans or other vertebrate animals will be labeled to show a caution statement in no smaller than eight-point type, such as "Do Not Use for Food, Feed or Oil."

   Sample label for general-use substances:

   This seed treated with Captan. Do not use for food, feed or oil purposes

The two labels above are minimum requirements, and the label may contain additional information, such as (a) Purpose of treatment, (b) Antidotes, (c) Safety precautions, and (d) Procedures to follow in case of an accident.

Coloring Grain Seed

The U.S. Food and Drug Administration (FDA) regards as adulterated any interstate shipment of food seed, such as wheat, corn, oats, rye, barley and sorghum, if they bear a poisonous treatment in excess of an acceptable regulated level (see below) **unless** such seeds have been given an unnatural appearance by a suitable color to prevent their use by man or as feed for animals. This regulation is in Section 408 of the Federal Food, Drug and Cosmetic Act.

Most seed-treatment pesticides now come from the manufacturer with the dye or color added as a convenience to the operator. However, some seed processors prefer to add additional dye with the pesticides at their plants so that the desired color is obtained. Dyes approved by EPA cause no apparent injury to seed germination or danger to personnel processing or using the seed.

Carriers, Binders and Stickers

These materials are listed on the label as inert ingredients. There is no requirement that the name of these materials be given. They are selected by the manufacturer, approved by the Environmental Protection Agency (EPA), usually neutral in pH, and nontoxic to humans, and they cause no apparent damage to the germination of the seed. They are added to increase the adherence of the pesticide to the seed, prevent dusting-off, and/or cut down the dusty conditions in the processing plant.

SAFETY IN TREATING

Some precautions in custom-treating of seed are listed below.

1. The manager should supply the local medical doctors with a label for each toxic pesticide being used or sold. The manager should ask the doctors to have on hand antidotes for all products and be prepared in case of an emergency. For help in a chemical emergency involving a spill, leak, fire or exposure, a person can call day or night: CHEMTREC at 1-800-424-9300 (toll-free). This number is used nationally by the pesticide industry for emergencies.

2. The manager should have copies available of pertinent label information on pesticides he or she is applying to seed as a custom service or for sale in bulk so that a copy can be given to each customer to take home with the treated seed. Refer to the section in this study guide on PESTICIDE LABELS. There have been cases where children or animals have gotten into, handled or eaten treated seed, and the parent or owner did not know what pesticides were on the seed. If the processor had supplied the customer with a sheet giving this information, the customer could immediately have given this information to the doctor by phone. General-use pesticides applied to seed are not sufficiently toxic to be a problem, but restricted- use materials can be.

3. A seed-treating facility should not be operated where pesticide dust or fumes reach food, feed or oil commodities or personnel such as office help who are not properly dressed to be protected from the dust or fumes. Lining the seed-treating room with polyethylene sheeting may be all that is needed.

4. The applicator should wear personal protective equipment (PPE) as specified on the label. Items that may be listed on the label of a pesticide container are: (a) a long-sleeved shirt and pants, (b) chemical-resistant headgear for overhead exposure, (c) protective eyewear, (d) a chemical-resistant apron when cleaning, mixing and loading, (e) chemical-resistant footwear plus socks, (f) chemical-resistant gloves, (g) respirator designed for use with the material. Respirator filters should be on hand at all times and changed as often as required in the filter instructions.

5. One or more copies of a container label should be available at all times at the entrance to the treating room for workers to read and refer to immediately in case of an accident or illness. IT MAY BE NECESSARY TO APPLY FIRST AID BEFORE A PHYSICIAN CAN BE REACHED.

6. Personnel should not stay in the treating room any longer than necessary to lessen possible contact with the pesticides. They should not inhale the dust or

vapor or allow such material to contact their skin or eyes.

7. Operators should wash thoroughly with soap and water before eating, smoking or using the bathroom. Bathe immediately after work, and change all clothing. Wash clothing thoroughly with detergent and hot water before reuse. In case of pesticide contact, immediately remove contaminated clothing and wash skin thoroughly with soap and water for at least 15 minutes.

8. A safety shower should be installed in the immediate vicinity to the applicator.

9. An EXHAUST system should be installed to remove toxic vapors and dust from the operating area. The exhaust should discharge into a cyclone or bag-type dust collector.

10. Special, tightly woven bags or polyethylene- or foil-lined bags are recommended for some seeds treated with a restricted-use pesticide. Seed should be thoroughly dry before going into the bag, as excessive moisture can cause rapid deterioration of the seed.

11. Store treated seed in labeled containers in a dry cool place away from food or feed products. Refer to the PESTICIDE LABELS section.

12. Seed-treatment equipment should be thoroughly cleaned after use, as some pesticides are corrosive and others settle out and cause clogging of the equipment. If more than one pesticide is used, clean out thoroughly to avoid cross-contamination of the treated seed. The names of the cleaners and how to use them should be obtained from the formulator of the seed- treatment material. Do not run contaminated water into the public sewer. Check with proper authorities when large amounts of waste water are involved.

13. Application equipment should be checked periodically to insure proper calibration and application rates.

14. In communication before and during the treating season, the manager of a custom-application business should suggest to growers that they bring in for treatment a little less seed than is to be planted so they won't have leftover treated seed. A grower can treat, by the drill-box method, enough to finish the acreage. Growers should also be informed that any treated seed in a market grain can cause the grower's whole truckload of grain to be refused. Any treated grain in a freight car or truck can result in the whole carload being condemned.

15. Pesticide containers should only be reused if putting the same chemical back in. If not possible to reuse the container, triple-rinse it, puncture it so that it can't be used for other purposes, and send it to the landfill for disposal.

APPLICATION EQUIPMENT

Commercial seed-treatments are designed to apply accurately measured quantities of pesticides to a given weight of seed. Too much pesticide may injure seed, and too little is often not effective. Both are illegal, so equipment must be kept properly adjusted at all times. The equipment supplier should provide this help. There are three types of commercial seed- treatments on the market -- liquid treatments, slurry treatments, and dust treatments.

The following is a discussion of the operation of the treating equipment as supplied by a manufacturer.

Liquid Treatments

These are generally designed to apply true liquids. The treaters use the weight of the seed to operate the seed- and chemical-measuring system. The amount of seed measured is controlled by placement of the counterweight, while the amount of chemical measured at each trip of the weighpan is determined by the size of chemical cups used in the metering tank or concentration of the liquid used.

Each time the weighpan trips, seed go to the retarding hopper, where it's gradually released to a dispersion cone. At the same time, chemical is delivered to the chemical cup receptacle and flows through a hose to a revolving disc that atomizes the chemical into penetrating mist. As seed falls over a dispersion cone and through the

treating chamber, it's enveloped by chemical mist that contacts even the hard-to-reach indentations of the seed.

The liquid method is especially recommended when small amounts of chemical must be applied to relatively large quantities of seed. Any free-flowing seed can be treated through a liquid treater. Seeds that are not free flowing (certain grasses) can be treated by the liquid method with the cottonseed treater. All liquid chemical products, ready-to-use fungicides and insecticides, slurry products, and inoculation materials can be applied through the liquid treaters. A special liquid treater for sugar-beet seed sprays fungicide, insecticide and dyes on seed as the seed is rotated in a large drum.

Slurry Treaters

These are generally designed to apply water suspensions of wet-able powders. Like liquid treaters, metered slurry treaters use the weight of seed to operate the seed- and chemical-measuring system. The amount of seed measured is controlled by placement of the counterweight, while the amount of chemical is measured at each trip. The weighpan is determined by the size of chemical cups used in the metering tank and by the concentration of the pesticide in the slurry.
Each time the weighpan trip, seed flows through the measuring unit and into the film coater. At the same time, chemical is delivered to the chemical-cup receptacle and flows through a hose to the film coater, where it joins the seed.

As the seed and chemical are conveyed through the film coater to the discharge, they tumble together, producing an even coat of chemical on each individual seed. This mixing action before final discharge also allows some moisture in the slurry to evaporate from the seed, for easier handling after treating.

Dust Treaters

A specially designed machine treats beans, grasses and other commodities where such treating is still in demand. Measured amounts of powder are uniformly and continuously applied to the seed by use of a vibrating feeder from a control. The machine is equipped with a powder hopper with positive fluffing action and variable speed drive assembly on the film-coating unit.

PROTECTING GROUNDWATER AND ENDANGERED SPECIES

INTRODUCTION

Federal and state efforts to protect groundwater and endangered species have resulted in special requirements and restrictions for pesticide handlers and applicators. Pesticides that are incorrectly or accidentally released into the environment can pose a threat to groundwater and endangered species. Whether pesticides are applied indoors or outdoors, in an urban area or in a rural area, the endangered species and groundwater must be protected and state and federal agencies rigidly enforce this requirement.

The need for special action by the pesticide handler/applicator depends on site location. Groundwater contamination is of special concern in release sites where groundwater is close to the surface or where the soil type or the geology allows contaminants to reach groundwater easily. In the case of endangered species, special action is normally required in locations where the species currently live or in locations where species are being reintroduced. The product labeling is the best source to determine if pesticide use is subject to groundwater or endangered species limitations.

The U.S. Environmental Protection Agency (EPA) establishes the specific limitations or instructions for pesticide users in locations where groundwater or endangered species are most at risk. These limitations and instructions may be too detailed for inclusion in pesticide labeling. In such cases the labeling will direct the applicator or handler to another source for instructions and restrictions. The legal responsibility for following instructions that are distributed separately is the same as it is for instructions that appear on the pesticide labeling.

PROTECTING GROUNDWATER

Groundwater is water located beneath the earth's surface. Many people think that groundwater occurs in vast underground lakes, rivers, or streams. Usually, however, it is located in rock and soil. It moves very slowly through irregular spaces within otherwise solid rock or seeps between particles of sand, clay, and gravel. An exception is in limestone areas, where groundwater may flow through large underground channels or caverns. Surface water may move several feet in a second or a minute. Groundwater may move only a few feet in a month or a year. If the groundwater is capable of providing significant quantities of water to a well or spring, it is called an aquifer. Pesticide contamination of aquifers is very troubling, because these are sources of drinking, washing, and irrigation water.

Utah has implemented a comprehensive and coordinated approach to protect groundwater from pesticide contamination. Formulation of the Utah Groundwater and Pesticide State Management Plan is a cooperative effort between federal, state, private agencies, producers, and user groups. It provides a basis for continuing future efforts to protect groundwater from contamination whenever possible. Furthermore, this plan provides agencies with direction for management policies, regulations, enforcement, and implementation of groundwater strategies.

Utah recognizes that the responsible and wise use of pesticides can have a positive economic impact, yield a higher quality of life, enhance outdoor activities, and give relief from annoying pests. The EPA has authorized the Utah Department of Agriculture and Food (UDAF) to enforce the protection of groundwater from pesticides.

The UDAF, in concert with cooperating agencies and entities, demands strict compliance with all pesticide labels, handling procedures, and usage to protect groundwater in the state.

Prevention of groundwater contamination is important, because once the water is polluted, it is very difficult and costly to correct the damage and in some instances impossible. City and urban areas contribute to pollution because water runoff can contain pesticides. Shallow aquifers or water tables are more susceptible to contamination than deeper aquifers or water tables. Sandy soils allow more pollution to move than clay or organic soils, because clays and organic matter adsorb many of the contaminants. For more information about what groundwater is and where it comes from, read the study manual ***Applying Pesticides Correctly: A Guide for Private and Commercial Applicators.***

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended, establish a policy for determining the acceptability of a pesticide use or the continuation of that use, according to a risk/benefit assessment. As long as benefits outweigh adverse effects, the EPA can continue to register the pesticide. Although the intent of a pesticide application is to apply the pesticide to the target or pest, part of the pesticide will fall on the area around the target or pest. Rain or irrigation water then can pick up the part that is not degraded or broken down and carry it to the groundwater via leaching.

There are many factors that influence the amount of pesticide contamination that can get into groundwater. The major factors are the soil type, soil moisture, persistence in soil, placement of the pesticide, frequency of application, pesticide concentration and formulation, pesticide water solubility, and precipitation. Each of these factors will influence the amount of pesticide that can penetrate the soil surface, leave the root zone, and percolate into groundwater.

Although some pesticides may have a high adsorption quality, when they are applied to sandy soil, they may still migrate to the water table because there are few clay particles or little organic matter to bind them. The management and use of pesticides is up to the individual applicator and/or landowner as to whether safe practices are used. Groundwater is a very valuable resource and it must be protected from pesticide contamination.

PROTECTING ENDANGERED SPECIES

The Federal Endangered Species Act lists the three classifications as endangered, threatened, and experimental. Endangered has the highest level of protection. The phrase "endangered species" is used when referring to these classifications. This Act was passed by Congress to protect certain plants and wildlife that are in danger of becoming extinct. A portion of this Act requires EPA to ensure that these species are protected from pesticides.

EPA's goal is to remove or reduce the threat to endangered species that pesticides pose. Achieving this goal is a portion of the larger continuing effort to protect species at risk. Normally these restrictions apply to the habitat or range currently occupied by the species at risk. Occasionally the restrictions apply where endangered species are being reintroduced into a habitat previously occupied.

Habitats are the areas of land, water, and air space that an endangered species needs for survival. Such areas include breeding sites, sources of food, cover, and shelter, and the surrounding territory that provides space for normal population growth and behavior.

Utah's endangered species plan is a cooperative effort between federal, state, private agencies, producers, and user groups. This plan provides agency direction for regulations, enforcement, management policies, and implementation of threatened and endangered species protection strategies.

EPA launched a major project known as Endangered Species Labeling (ESL). The goal is to remove or reduce the threat to endangered species from pesticides. EPA has the responsibility to protect wildlife and the environment against hazards posed by pesticides. The ESL program is administered by the U.S. Fish and Wildlife Service (FWS) in the U.S. Department of Interior. The FWS reports to EPA concerning endangered species. EPA and FWS work cooperatively to ensure that there is consistency in the pesticide restriction information provided to agencies and pesticide users.

The UDAF acts under the direction and authority of EPA to carry out the ESL project as it relates to the use of pesticides in Utah. Utah's web sites with maps designating the habitat boundaries and listings of endangered plants and wildlife is: www.utahcdc.usu.edu