cultivation that doesn't exist in the wild anymore.

LINDA ABERBOM: You can also check with the Botanic Gardens. They are continually collecting information on the status of endangered species.

WILBUR BLUHM: In the Pacific Northwest the Botanic Gardens are much involved in this problem. Your question is an excellent one. I think there is an ethic here we must all subscribe to when we are working with endangered species to make sure we are not part of the problem.

MECHANICAL AND HAND METHODS FOR PROCESSING SEED

SUSAN SCHAFF

Mistletoe Sales
P.O. Box 1275
Carpinteria, California 93013

Seed processing is a vital part of making available high quality seed. A good seed processing job can assure growers of maximum germination and true-to-type seed, plus the seed will store better. The quality of seed is improved during processing by removal of contaminants such as seeds of other crops, weed seed, inert material, etc. and by upgrading or eliminating poor quality seed.

Seed processing is aided by proper collection of material in the field. There are many methods of collecting seed but all generally produce either dry or wet material to process. The seed processor will evaluate the crop to determine the best method or methods of separating the seed from the contaminants.

An important prerequisite for efficient and effective seed cleaning of dry seed is that the seed is completely threshed and as free flowing as possible. This may require removal of awns or beards or breaking up of pods, seed heads, or seed clusters. To minimize losses of good seed, these clusters, heads, or pods must be completely broken up before the lot is cleaned. Often a debearder machine is used to complete threshing and to remove appendages or hulls that interfere with the flow of the seed.

The debearder has both rotating and stationary beater arms that are permanently fixed inside the machine. When the material is fed into the machine, the seed is rubbed by the rotating arms and is rotated toward the discharge gate. Weights can be placed on the gate to control the length of time the seed is in the debearder. Generally brittle seeds, such as *Isomeris arborea* or lupines are run through the

machine quickly so as to prevent chipping of the seed, while a type like *Achillea tomentosa*, which consists of many fine seeds in a head, may be held in the debearder longer so the head will be thoroughly broken up and the seed released. Following this treatment, most seeds are cleaned on the air screen machine.

The air screen machine is the basic cleaner in most seed processing plants. Almost all dry seed must be cleaned by an air screen cleaner before specific separations can be attempted. Many seed lots can be satisfactorily cleaned by this machine alone. The machine size can vary from small, two screen models to large industrial cleaners with 7 or 8 screens.

As before, in order for seed to be separated, cleaned or processed, the components of the lot must differ in some physical characteristic. The air screen machine is able to make separations on the basis of the differences in both size and shape. This enables the air screen machine to use three cleaning elements:

1. Aspiration: light material is removed from the seed mass by air;

2. Scalping: good seed is dropped through openings in the screens but larger material is carried over the screen to a separate spout;

3. Grading: good seed rides over the openings in the screens and smaller particles fall through.

When the seed processor sets up the air cleaner for a particular crop, he selects the screens to use according to the size and shape of the crop seed. He may measure the seed or do test samples with screens to determine what size holes to use. While running the seed through the machine, adjustments in air are made to provide the best separation.

The seeds to be cleaned are fed from the hopper by the feed roll which can be controlled to regulate the amount of material entering the machine. They first pass through an upper air system which acts as a vacuum to remove light chaff and dust. The seed mass then falls on the top screen which performs rough scalping. The perforations in the top screen are large enough to readily drop all the crop seed but small enough to scalp off large foreign material such as stems, sticks, dirt, or weed seed. The seed that passes through the top screen is caught on the second set of screens which performs a close scalping, removing large foreign material or contaminating seeds that were small enough to pass through the top screen. Good seed that passes through the second set of screens is caught on the third set of grading screens which have perforations which drop out trash, weed seed, and dirt smaller than the crop seed. As the crop seed falls off this final set of screens, it passes through a lower air separation. This final draft of upward moving air removes light seed and trash not removed by the upper air and screens. For efficient cleaning the air draft should be strong enough to blow out a few good seeds.

After running a crop through the air screen machine, further cleaning may still be needed. The seed may be run through the air screen machine again using different screens or another type of machine may be more effective.

Undesirable seed and contaminants are often so similar to good seed in size, shape, and seed coat characteristics that the air screen cleaner cannot make an efficient separation. The undesirables may differ from the good seed in unit weight or specific gravity. For example, insect damaged seeds may retain the same dimensions but are lighter due to the interior destruction of the seed by insects. Deteriorated, moldy, or rotten seed are usually similar in size but have a lower specific gravity and thus are much lighter. Empty or sterile seed often develops normally and looks good in size and shape although the embryo has not developed and is lacking. Empty seed is always much lighter than fertile seed. Sometimes soil particles, gravel and sand are similar in size and still remain after basic cleaning. These contaminants are usually heavier than the crop seed. Contaminating crop or weed seed may be the same general size and shape but heavier or lighter because of differences in structure or composition. Contaminating seed or material differing from crop seed in unit weight or specific gravity can be separated with a specific gravity separator or gravity table.

The gravity table is a basic machine used as a finishing cleaner. It was originally developed by the mining industry to separate and grade ore. The seed industry has adopted the concept of the gravity table to separate seed and contaminants and to grade seed. It will separate seeds of the same size but different densities or seeds of the same densities but different sizes. It will not separate a mixture of sizes and densities.

The seed to be separated flows across an inclined deck mounted on incline toggles which cause an up and down motion and a backward and forward motion to occur at the same time. In addition, the deck is covered with an open mesh material through which filtered air is blown. The air floats seed so it becomes stratified into layers. The light seed rises to the top and the heavier seed settles to the bottom. The up and down motion of the deck pitches the seed up so the stratification is quickly affected. As soon as the seed is stratified, the layers separate and move in the direction dictated by their specific gravity. The back and forth motion causes the heavier seed to travel uphill because those seeds are in contact with the deck surface while the light seed flows downward on a cushion of air. As these layers move in opposite directions, they also move across the deck toward the discharge end. The result is that different grades of seed fall off the discharge end of the deck. The light seed discharges on the lowest side, while the heaviest seed discharges along the highest side. The middle is an intermediate mixture of heavy and light material, which usually contains too many good seeds to

discard so it will be recleaned to salvage the good seed.

Wet seed, such as *Asparagus densiflorus, 'Sprengeri'* or *Nandina domestica* berries are processed in a different way. The seeds need to be removed from the pulp and then further processed to a dry clean seed state. First, large debris such as leaves, sticks and stems are removed so only the berries remain. This may be done with the air screen cleaner, water flotation, fans, screens or, in the case of many palms, hand stripping.

The machine used for depulping the berries is a Dybvig seed cleaner named after the inventor, Melvin Dybvig. The Dybvig, or "Green Machine" as we call it, has a hopper, a cleaning plate, and electric motor with a chain driving variable speed sheaves. The cleaning plate is adjustable for various sizes of seeds. As the cleaning plate whirls the seeds inside the hopper, the seeds rub against each other and the sides of the hopper which removes the pulp. The addition of a stream of water washes away the pulp. Larger depulped seeds are flushed out one side spout while the pulp goes under the plate and out another spout. When smaller seeds, such as *Feijoa sellowiana* are cleaned, the seeds will go out with the pulp mass.

The water sluice is used to further separate the seed from the pulp and any other contaminates such as rocks, dirt, and other types of seeds. Our sluice box is 20 feet long with 5 areas where four wooden boards can be stacked to create dams. The seed and debris or the seed and pulp mixture is put into the sluice box. A dam is created to hold the material then water is added. The water causes the material to stratify in layers. When agitated, the pulp, light seeds and other light debris float to the top, the seeds form the middle layer, and dirt and rocks settle to the bottom. When the top board of the dam is removed, the top layer of light seed, pulp and debris float over the dam and out the sluice box. This material is allowed to flow away to debris holding ponds. The seed processor continues to agitate the material, to add water and adjust gates until the seed is allowed to flow out of the sluice box onto screens. Finally, the dirt and rocks are flushed out to the debris holding ponds. The cleaned seeds are spread on screens to dry. After drying, further processing is often necessary to remove the final bits of debris and contaminating seeds.

We have discussed five machines or methods that are used to process seeds. The nurseryman collecting his own seed may not have access to sophisticated machinery however, except for the gravity table. The principles of cleaning used by these machines can be duplicated by various hand methods.

The debearder breaks up the seed head, pods, and clusters by rubbing them against each other and the rotating arms. Individual screens can also be used to hand rub the seed heads, pods, or clusters to affect the same breaking up action. Other techniques include

stomping of dry material in a barrel or hand threshing in a sack. All methods will cause the seed mass to more easily flow and be separated.

The air screen cleaner uses both air and screens to separate seeds by size and shape. Hand held screens with various size openings can be shaken to separate seed from other material either by scalping—so the good seed falls through the screen and other debris remains on the top—or by grading, so the good seed stays on the top of the screen and the smaller debris falls through. A fan set behind catch trays can be used to aspirate the seed. As the seed mass is steadily shaken in front of the fan, the moving air carries the material. The heavy seed and stones will fall in the tray closest to the fan. The next tray will be a mixture of good seed, light seed, and some heavier debris.

The Dybvig cleaner depulps fruit by rubbing the berries against each other and the cleaner. Fruit can also be depulped by rubbing the berries against a screen or by placing the wet fruit in a container and stomping. We use this method in cases where we feel the Dybvig is too aggressive and will damage the seed.

The water sluice is used to stratify and separate seed from debris and light seed as well as heavy dirt and stones. Putting the seed mass in a container, adding water, stirring, and then rocking the container will cause the same stratification. The components will settle in layers. The light seed and light contaminants will float to the top and can be either scooped or poured off. The seed can be poured onto screens and the sediment discarded.

In conclusion, expert seed processing improves the quality of seed for storage and for the grower. We have discussed only some of the methods and machines available. There are many more that can be used but all are dependent on the skill and knowledge of the seed processor who is constantly challenged by his craft.