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Research in Seed Separations

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RESEARCH IN SEED SEPARATIONS

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The U.S. Department of Agriculture has conducted engineering studies of seed harvesting and processing in Oregon since 1953. Studies were also conducted in South Carolina from 1951 to 1963. Harvesting research activities have included harvest loss investigations, time-of-harvest studies, tests of existing harvesting equipment components, and development and testing of experimental harvesting equipment. Processing research has included studies of seed separating principles, evaluations of existing equipment for making separations and development and testing of improved equipment for seed cleaning.

Harvesting Research

Some of the equipment developed in the harvesting research program includes a suction harvester, a seed moisture tester, a versatile plot thresher, and an experimental combine. The combine has threshing belts rather than conventional cylinders, and has a new separating system consisting of a vertical rotary screen and two pneumatic separators. Field tests with the combine indicate that the new threshing and separating concepts have practical value.

Processing Research

New separators and related processing equipment have been developed in the processing research program. Special indent cylinders were produced to separate seed by length based primarily on indent diameter rather than indent depth. Purity analysis was mechanized by constructing a single-deck vibrator separator and a small velvet-roll separator to concentrate contaminants, and an automatic inspection station to increase analyst efficiency. A bounce plate unit was developed to separate seeds on the basis of differences in resilience. An effective blender was devised using adjustable electromagnetic feeders and a mixing cone. Several experimental models of scarifiers involving abrasion or hydraulic pressure were developed and tested. Transverse-flow fans were built to improve uniformity of air-flow distribution in pneumatic separators. Other equipment developed includes a vibrating-tube sampler and constant-flow feeders.

Recent processing developments now in commercial use are a multi-deck vibrator separator, a vertical rotating screen, and a friction separator.

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The vibrator separator classifies seeds primarily on the basis of shape and/or surface texture. It has proven highly effective in separating many types of seed mixtures. The unit consists of an inclined textured deck that is driven by an electromagnetic vibrator. Multiple-deck versions having 30 and 500 decks are being used to make such separations as watergrass from carrot, and pigweed from ladino clover or alfalfa.

A new vertical rotating screen that operates more effectively than flat screen separators has been developed for both harvesting and processing application (Figure 1). This machine has a cylindrical screen rotating about a vertical axis and oscillating up and down. In operation, a seed mixture is introduced into the cylinder and as it works downward the small seeds pass through the screen holes. A cleaning roll rotates against the outside of the screen to keep the holes clean, and an auger inside moves trashy material down through the cylinder. In addition to the single-screen model, a two-screen unit has been developed that divides mixtures into three size fractions at high flow rates. Important advantages of this new separator, over flat screens, include the ability to handle trashy materials, high capacity, and insensitivity to slope when used on a combine.

The friction separator efficiently separates rough particles from smooth ones (Figure 2). To date, it has been used primarily to remove dirt clods from beans. A small modified version of this unit is currently separating small seed such as dodder from alfalfa or clover. A commercial-size machine for small seeds is now under development.

Separation is accomplished by pairs of bars set at an angle across a moving friction belt. Each pair consists of a friction separator bar followed by a diverter bar. In operation, a stream of mixed, rough and smooth, particles is fed onto the belt just ahead of each separator bar. The smooth particles slide diagonally along the face of the separator bar into a conveyor trough. The rough particles roll under the separator bar and are intercepted by the diverter bar and moved across the belt into a second conveyor trough.

The machine will effectively separate many mixtures of seeds and contaminants. It will also substantially upgrade some seed lots by removing a low-quality fraction.

Other processing research has resulted in findings of use to industry. A magnetic study showed the importance of fine particle content of iron powder and moisture content in removing dodder and buckhorn plantain from alfalfa or clovers. Pneumatic separation research demonstrated the effects of column shape, feed rate, and other factors on selectivity of separation. Conveying research showed that seeds were transported efficiently in low-velocity pneumatic systems with a minimum of damage. Other separation studies involved such considerations as processing sequences, seed dimension analysis, and prin-

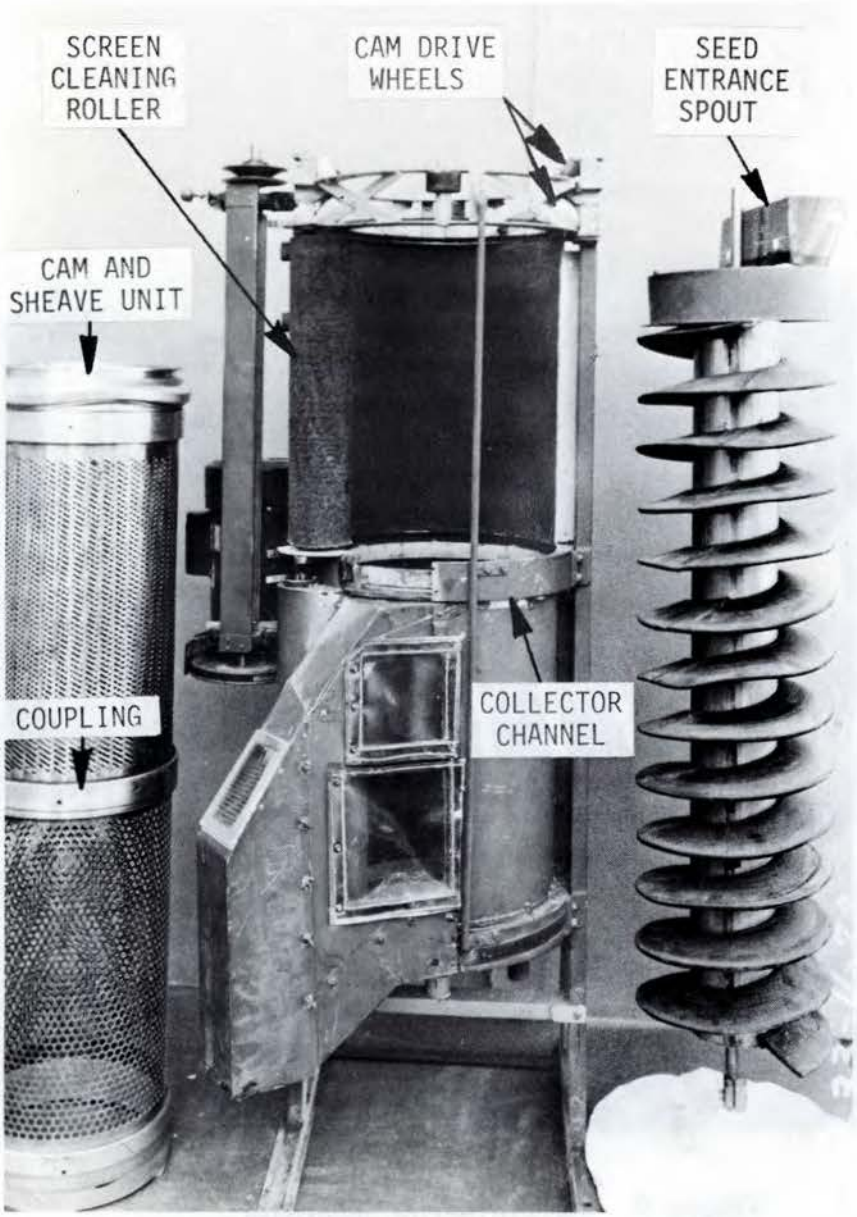

Figure 1. Two-screen Vertical Rotating Screen Separator shown partially disassembled.

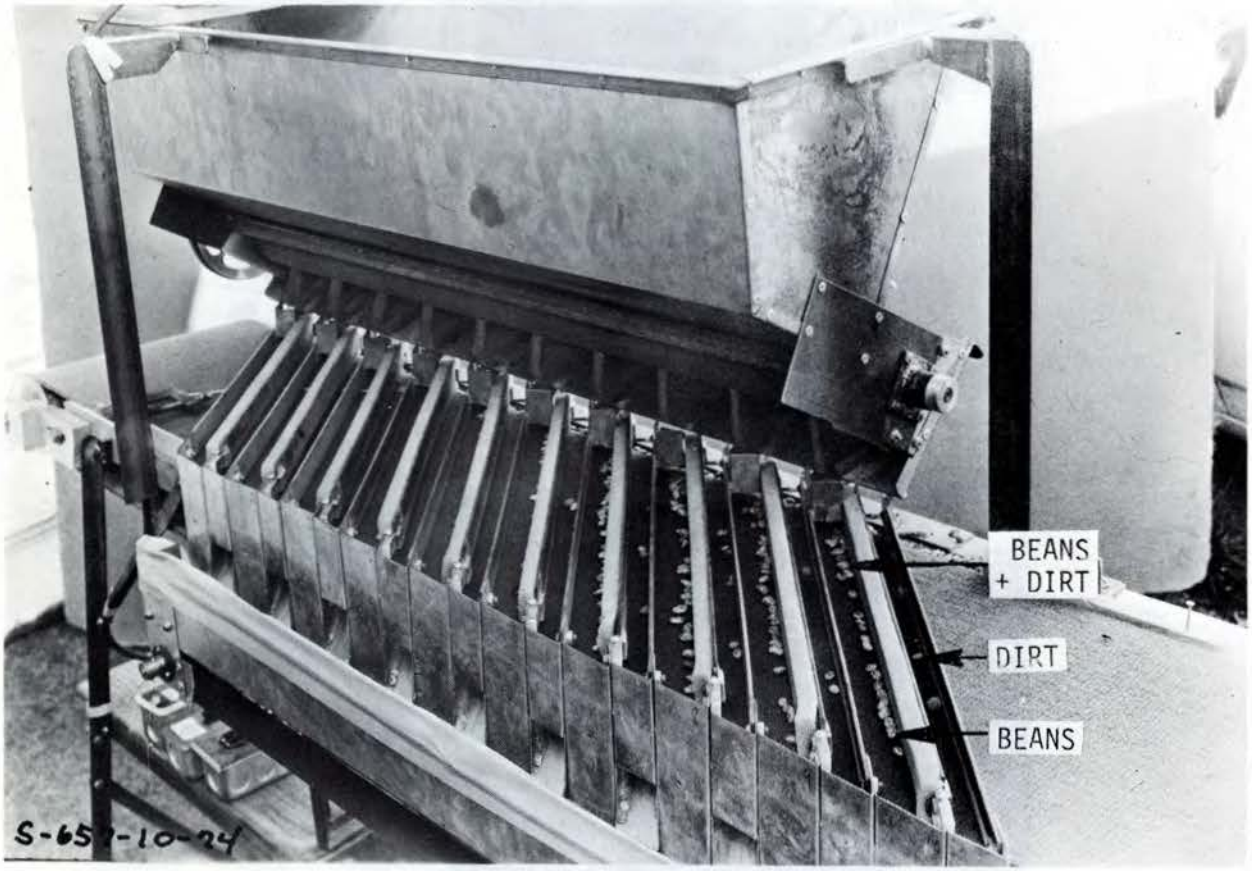

Figure 2. Multiple-row Separator.

ciples of separation. Research on separation problems from industry has determined specific answers for processors and resulted in the development of improved equipment and methods for seed processing.

Future Research

Research will be continued to find effective methods of separating seed mixtures that will be applicable to harvesting and processing of seed crops. Future investigations will emphasize a careful study of seed physical properties and methods of using differences in these properties to make separations. New methods of precise sensing, measuring, and differentiating, now used in other technologies, will be investigated for potential application in separation of seeds.