Present Status of Sugar Beet Seed Processing

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FULLY 90 PERCENT of the 1947-1948 United States sugar beet crop was planted with processed seed. Early beet-seed processing investigations started in 1941 at the University of California with the development of equipment for segmenting seed. (1) (2)[2]

During the first year or two after the adoption of segmented seed, growers and processors alike were of the opinion that the goal in seed processing was the production of single-germ units. Several processors succeeded in producing and marketing a product that was made up of 85 to 90 percent single-germ units. A final product having a germination of 85 to 90 percent was made possible through the use of gravity table separators and aspirators. However, the production of single-germ seed of high germination resulted in low recoveries. Often-times, 100 pounds of whole seed yielded only 30 pounds of processed seed, of which 5 to 10 percent produced abnormal seedlings.

Irregularities in field stands planted with segmented seed were attributed to poor planter metering and placement with the result that requests were made for improved planting equipment. Intensive laboratory and field studies made at the California and Colorado Experiment Stations assisted in making improved planting equipment (3) available -equipment capable of metering and placing one seed at a time with reasonable accuracy.

While the use of improved planting equipment improved regularity of stands planted with segmented seed having a high single-germ count, it did not give the final answer desired. When seed containing as many as 1.4 seedlings per viable seed unit was used, more uniform stands resulted with a surprisingly high percentage of beet-containing inches with single seedlings. Under a field emergence of 54 percent, 70 percent of the inches containing plants had singles.

By 1946, several of the seed processors were preparing and issuing seed that ran as high as 40 percent doubles (1.4 seedlings per viable seedball). In general, more uniform seedling stands resulted from the use of the seed. While the percentages of singles dropped somewhat, the advantage in labor saving did not decrease in the same ratio. Recoveries of seed in the processing plants were also improved.

Further research work relative to seed processing produced two new processes; namely, burr reduction and decortication. (4) Later, the two processes were combined and put into commercial use. With the exception of beets grown for one company, practically the entire 1948 sugar beet crop in California was planted for the first time with seed processed with this new equipment. The above-mentioned company used a commercial seed

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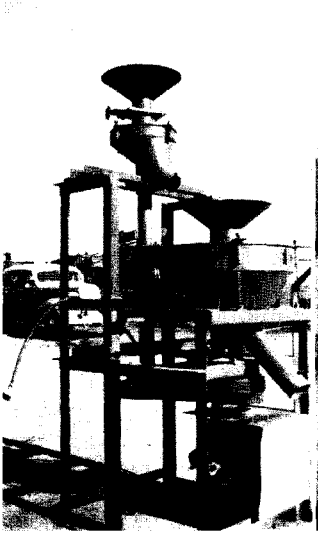
[2]The numbers in parentheses refer to literature cited.

huller for decorticating after first running the seed through a segmenter with a wide setting of the shear bar.

The equipment, figures 1 and 2, used for preparing the seed consists of a 1½ by 10-inch carborundum stone (Norton 37C24QV) and a 10-inch burr plate (Letz AA230) for the first reduction stage. The second stage consists of a 1 by 20-inch carborundum stone and a neoprene pressure pad 20 inches in diameter. The stones are mounted on vertical shafts and driven at a peripheral speed of 2,000 fpm through V belts from a common electric motor. Clearances between the stones and the burr and pressure pad are maintained at approximately 0.125 inch. A slight taper (⅛ inch per inch) halfway from the center to the outer edge of the pressure pad facilitates the feeding of seed. It was also found necessary to grind the corner, at the outer periphery of the pressure pad, at an angle of about 45 degrees in order to prevent the formation of a lip as the pad became worn. In operation the pressure of the seed against the pad caused the surface to stretch slightly beyond the edges of the stone which in turn reduced the wear on this small section, allowing the formation of an overhanging lip of neoprene which



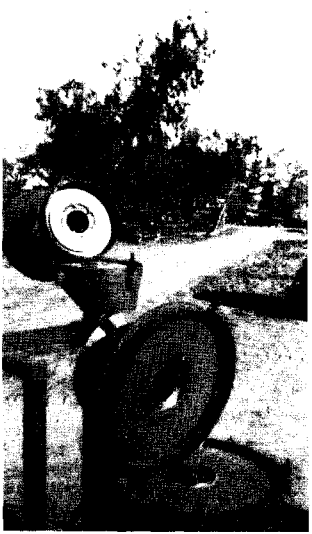


Figure 1.—Commercial seed-processing unit.
Figure 2.—Commercial seed-processing unit opened to show the two stones, burr plate and pressure pad.

prevented accurate adjustment between the plate and the stone when the machine was idle. Both units are enclosed in steel cases with hoppered bottoms. The inner wall of the case surrounding the burr and pressure pad is lined with a ½-inch layer of sponge rubber to reduce the shock to the seed as it leaves the stone and hits the wall. The seed is fed to the center of the wheels from the hoppers above. The rate of flow is regulated by an adjustable gate between the hopper and the burr reduction unit.

During operation, sack-run whole seed is fed directly from the hopper (figure 1) through the center of the burr plate to the center of the revolving stone. The seed is moved between the face of the stone and the burr plate by centrifugal force. This first stage operates as a pre-breaker, reducing the size of the larger seedballs to the extent that the entire sample will pass through a 13/64-inch screen. The output of the burr reduction unit feeds by gravity into the hopper above the decorticating unit. The partially reduced seed then passes between the neoprene pressure pad and the revolving stone with the result that most of the corky material is rubbed off, and many of the locules are opened, thereby releasing many of the germs. The discharge from this unit consists mainly of one- and two-germ seed pieces and a large volume of corky material removed from the seed. The seed is reduced to about 10/64-inch in size. The capacities of the 10-inch burr reduction unit and the 20-inch decorticating unit are comparable; namely, approximately 500 pounds of whole seed per hour.

Following the decorticating operation, the seed is cleaned and graded. The light, corky material, as well as the lighter seed pieces, can be readily removed through the use of an aspirator designed by Austin A. Armer.[3] In the majority of cases, final grading has been done between 10/64- and 7/64-inch round-hole screens. The exceptions have been to grade to 9-7 or 12-9 sizes. In the latter case, very little decortication was accomplished. Some processors use a gravity table separator for the final grading on the basis of density.

The results of preliminary runs with the machine are shown in table 1. Five lots of seed of 1,000 pounds each were processed to the 9-7 size. Final grading was done on a gravity table. One hundred pounds of whole seed having a germination of 90.4 percent and a seedling count of 1.9 produced 56 pounds of processed seed with a germination of 89.6 percent and a seedling count of 1.6. The recovery on the basis of total seed units and viable seed units amounted to 84.4 and 83.7 percent, respectively. Further experience with this unit brought the recovery up to 60 percent by weight during the production of some 330,000 pounds of finished seed. Recoveries, by weight, of 65 to 70 percent are accomplished when the seed is reduced only to the 10-7 size.

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Seed processed in the above manner is superior to segmented seed in every respect except one; namely, singleness of germ, and this may prove to be an advantage. Comparative laboratory germination trials showed that seed processed by segmentation produced 1.2 to 1.4 seedlings per viable seed unit as compared to 1.5 to 1.6 for decorticated seed. The size of the seed was the same for both processing methods. This was fortunate in that equipment adapted to plant one would handle the other. In addition to a marked improvement in the recovery of seed during the new processing operations, the new product germinated equally as well as the original seed, was less sensitive to planting depths and did not produce as many abnormal plants. The processed seed has a smoother exterior than either segmented or whole seed and is more dense, which improves its flow through planting equipment.

Table 1.—An analysis of preliminary runs consisting of 5-1,000 pound samples processed by combination of burr reduction and decortication. Seed reduced to 9-7 size.

Germination		Seedlings per seed unit				Seedlings per viable unit	Seeds per pound	Percent recovery		
Normal	Abnormal	1	2	3	4			Weight	Number	units
					Whole					
90.4		25.0	47.3	15.3	2.8	1.9	28216	100	100	100
					Decorticated					
89.6	1.9	35.8	48.8	4.8	0.2	1.6	42492	56.0	84.4	83.7

Relative rates of emergence of whole, segmented and decorticated seed were determined under various soil-mositure and temperature condtions. (5) The only real differences came at the lower levels of soil moisture. For example, the test run at 9 percent soil moisture and 50 degrees F. showed germination of decorticated seed 56 percent complete at the end of 20 days as compared to 20 percent for segmented seed and 14 percent for whole. Such differences could mean the difference in obtaining a stand of beets under unfavorable germination conditions.

Sugar beet seed processing should be considered only as a temporary measure to overcome some of the obstacles of using whole ungraded beet seed. Plant breeders are making definite progress toward the production of single- and double-germ seed. In the light of tests reported in this paper and those conducted in other sections of the country, it is evident that industry does not want single-germ seed unless it can be developed to the point of giving better field emergence. The chief reason for most seed processing is to prepare the seed for precision planting. For the time being, at least, it is necessary to reduce the size of the seed to the point where its variation does not exceed 3/64-inch if available precision planting equipment is to be used. No doubt, some polishing will still be required when the plant breeders are ready to release the new seed in order to facilitate precision planting. This could be accomplished through a light decortication.

Literature Cited

(1) BAINER, ROY.
1942. Seed segmenting devices. Proc. Amer. Soc. Sugar Beet Tech., Third General Meeting. pp. 216-219.

(2) BAINER, ROY.
1943. New developments in sugar beet production. Agri. Eng., Vol. 24, No. 8, pp. 255-258. August.

(3) BAINER, ROY.
1947. Precision planting equipment. Agri. Eng., Vol. 28, No. 2, pp. 49-54. February.

(4) BAINER, ROY, AND LEACH, L. D.
1946. Processing sugar beet seed by decortication, burr reduction and segmentation, Proc. Amer. Soc. Sugar Beet Tech., Fourth General Meeting. pp. 625-639.

(5) LEACH, L. D., BAINER, ROY, AND DONEEN, L. D.
1946. Emergence and rate of emergence of sugar beet seed as influenced by seed preparation, soil moisture and temperature. Proc. Amer. Soc. Sugar Beet Tech., Fourth General Meeting. pp. 107-116.