SHEARING AND GRAVITY CLASSIFICATION OF SEED

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For the season of 1944 the Utah-Idaho Company will make available a seed product sized 7/64 inch to 9/64 inch with an approximate germination of 90 percent. This seed will be used in all plantings made with the Cobbley precision planter developed by the agricultural engineering staff of the Utah-Idaho Sugar Company. The primary objective in the use of this closely sized high-germination seed is to make possible a complete mechanical thinning operation. The possibility of a complete mechanical thinning operation will and must depend upon the number of plants that emerge in the field, the number of these plants that emerge as singles and the manner of their distribution.

Counts made on field emergence during the spring of 1943 revealed the fact that for every 100 seedballs planted averaging 70-percent germination only from 30 to 35 seedlings emerged. We were not aware that because of injury a certain part of the seed that would germinate on blotters would not emerge in the field. Air pockets, local moisture conditions, frost, fungi attacks and improper planting are some of the conditions that did and in the years to come will again take their toll on field emergence. The added insurance that 90 germination seed will give is a factor that must be recognized.

In standardizing the size range of this seed we have been guided by the low germination of that seed below 7/64 inch in size and the large proportion of multiple-germ segments in that seed above 9/64 inch in size. This is especially true when high germination whole seed is segmented. The physical quality of this seed is greatly improved in the gravity separation process in that a definite scarification takes place, leaving the seed segments generally free of corky material. This, as well as the close sizing, adds tremendously in planting efficiency. The manner of distributing this seed will be discussed in a later paper by Rowland M. Cannon.

At the present time we are using 3" faced, 24 grit stones 14 inches in diameter. The major part of the whole seed to be segmented will be from 75 percent to 80 percent germination and the greater part of our experimental work has been on seed in this range.

With 75 percent to 80 percent germination seed recoveries on the 7-9/64 inch size range run between 35 percent and 45 percent prior to the gravity separation. We have attempted, in a great many ways, to increase this recovery but have not yet been able to better our general recovery of about 40 percent.

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Considerable difficulty has been experienced in keeping the percentage of multiple-germ seed segments at a reasonable figure and in some cases in controlling doubles an excessive amount of injury has been evidenced in false germinations. A close examination of the segmented product revealed that the major part of the doubles was from 2-germ seedballs that had passed the shearing bar and had suffered no more injury than having the cork removed. The greater part of the segments germinating falsely appeared to be from the large seedballs that had been shattered excessively. There was very little evidence of multiple-germ seed segments coming from the large seedballs of the whole seed. As a result of this examination we decided to try sizing the seed before segmenting.

Three 110-pound bags of U. S. No. 22 were segmented in each trial. The seed was separated into two sizes; the large size being plus 4 mm. and the small size that portion below 4 mm. The large size averaged approximately 57 percent of the whole seed, leaving approximately 43 percent in the small size. The oversize from the large seed segmented product was caught and weighed and later added to the small whole seed as it was being sheared at the same bar setting. The oversize from the small whole seed was returned to the shearing bar in a continuous cycle and segmented with the small size.

As can be seen on table 1, our suspicions would seem to be confirmed. The setting at which we received our greatest recovery in segmenting the large size was by no means the setting at which recoveries were greatest on the small size. This was also true when reversed. The best recoveries on the small size came at a setting that gave a very poor performance on the large. We are forced, in the production of 7/64 inch to 9/64 inch segmented seed, to use a rather fine setting in order to get a maximum amount of singles. If this work is a true indication of the facts we have been receiving but a small recovery from the larger whole seedballs. It is from the larger seedballs that one would normally expect to receive the major portion of multiple-germ seed segments. As the table reveals, however, the number of doubles in the product from the large seed was only approximately one-third the number that appeared in the segmented seed from the small size. This, again, would confirm the belief that the larger seed was being literally shattered. It is interesting to note that while the original germination of the large whole seed is approximately 10 percent higher than the small whole seed the order is definitely reversed in their segmented products. It will also be noted that both the large and the small whole seed, when segmented individually, produced higher germinating products than the seed that was segmented without sizing. Finally, the pounds per hour was increased to a certain degree in segmenting the large separately as against using unsized seed and the pounds per hour segmenting the small was increased decidedly.

We are at the present ti e doing more work on this problem.

Low-germination seed will also be a problem that we will have to meet this year as well as in the years to come. In attempting to segment low-germination seed we have experienced very heavy losses, both in recovery and in germination. A considerable amount of seed germinating 45 percent was segmented with the same procedure that we had used in segmenting high-germination seed. The segmented product from this seed varied from 16 percent germination to approximately 30 percent. It can be readily seen that losses sustained in this manner are excessive. In the first place we were operating 55 percent of the time on non-viable material which increased the costs of the operation in a like proportion and cut our capacity to a very large extent. In view of this unsuccessful attempt to handle this low-germination seed we tried improving the seed before segmenting. We found that the greater part of the non-viable material was in the small whole seed. The seed was sampled and broken down into its various sizes; namely, that portion minus 3-1/2 mm., from 3-1/2 to 4 mm., from 4 to 4-1/2 mm. and that part that was plus 4-1/2 mm. An example of this sampling is shown on table 2, example A. Twenty-one and two-tenths percent of the total of this material averaged only 5 percent germination. Twenty-seven and seven-tenths percent averaged 13 and as can be seen, by removing these two size ranges, or the larger part of them, the germination of the whole seed can be raised to a point where it would be profitable to handle it. At the same time we have eliminated the smaller sized seed and can do a much more effective job of segmenting, with greater recovery, than could be possible by segmenting the entire product. Some examples of our results in increasing the germination of the whole seed can be seen in example B on table 2. We feel that we could well afford to take even lower recoveries than those shown under B in order to have a higher germinating whole seed to work with.

We have been very successful in the work that we have carried on with the gravity table. It should be noted, however, that the ability of the gravity separator to give maximum recoveries is dependent upon the quality of the material going onto the table. In making 90 percent germination seed our end product, we find it is necessary that the seed that comes onto the table be in the neighborhood of 80 percent germination if normal recoveries are to be expected. If an excessive amount of light material is introduced at the table it becomes necessary to use more air as well as more pronounced lateral and longitudinal raises which, of course, lowers the recovery on the high-density spouts of the table. A much more efficient job of making the separation has been experienced where the material entering the table is fairly well scarified. It will be noted in table 3 that the No. 5 spout generally has a fairly high or a medium germination. This can be attributed, in the main, to the fact that most of the viable material in this spout has enough corky material still left on the seed to make it quite buoyant and it is floated off of the table with the light material. The gravity separator has a number of controls that determine the type of separation that is to be made. The side opposite to the side of discharge is elevated 1-1/2 inches when it is fully depressed.

As the occasion demands this elevation can be increased to the point desired. This is what is termed the lateral raise or elevation. The end of the table opposite to the end where the seed enters the table is also elevated to that point necessary for a proper separation; this being known as the longitudinal raise or elevation. The table has a controllable oscillating motion and it is this oscillating motion that conveys the high-density seed up and across the table. The deck of the table is, in most cases, a wire mesh through which an air blast is forced. This air draft can be controlled to the point desired. The separation process consists of setting the air blast to a point where it will lift the lighter material from the table and because of the lateral inclination as well as the direction of the air blast it is floated off of the table on the low side, which, in our terms, is the number 5 and 6 spouts. The heavier material, or in our case the viable seed, responds to the oscillating action of the table and literally walks up hill where it is discharged in the higher spouts. The quality as well as the quantity of the seed discharged through any spout can be raised or lowered by raising or lowering the lateral and longitudinal elevations. In attempting to make a separation it is best to begin with a minimum setting, both laterally and longitudinally and then increase to the point where the best job of concentrating can be accomplished. The more drastic the lateral or longitudinal elevation the more difficult it becomes to effect a concentration. We have been able to obtain our best work by maintaining the material on the deck of the table at about 1/4 inch to 3/8 inch deep. It is very important that the table be covered at all times, as any bare spot on the table tends to funnel the air blast and cause an uneven air distribution over the table. An excessive amount of air not only causes a heavy discharge into the number 5 and 6 spouts but also tends to float a certain part of the light material over the bed of seed into the high spouts. Care should be taken in setting up the table that it is level at its base and that there is absolutely no vibration of the base at any time. Table No. 3 is an example of how the quality as well as the recovery of the seed can be affected by varying changes on the table. This work was all done with seed averaging approximately 80 percent germination and we were running 700 pounds per hour.

It will be noticed that in the first setting shown on table 3 we were able to concentrate both the high-quality seed as well as the greater part of it in the first four spouts. As the longitudinal elevation increases 1/2 inch in each of the following three settings we lose this concentration to a marked degree. It will be noted that the number 5 and 6 spouts increase in germination each time the table is raised and the top spouts begin to decrease. This is also true in recoveries. As we increase the longitudinal elevation the amount of seed discharged from the number 5 and 6 spouts, as well as from number 4, is increased to the point where we have a very poor germination, notwithstanding the fact that the germination on the high spouts still remains fairly high. For an example, notice the geometric averages of the number 1 and 2 spouts at the different settings. At the number 1 setting the recovery was 35.6; at the number 2 setting,

Table No. I

Recovery and Germination Data from Shearing Sized Seed

Bar Setting	Pounds Per Hour Capacity	Recovery Data				Germ. of Whole Seed	Germination of Seed Sized 7/64" to 9/64"			
		% 7-9/64"	% Oversize	% Waste	% Total Recovery		% Singles	% Doubles	% Cotyledons	Total Germ.
Large Seed Size - Approximately + 4.00 m.m.										
.079	346	25.4	18.5	56.1	43.9	90	66	6	5	77
.080	543	18.2	35.9	45.9	54.1	94	69	6	4	79
.081	454	28.0	32.7	39.3	60.7	94	71	5	5	81
.082	352	41.7	22.8	36.5	64.5	91				
Small Seed Size - Approximately - 4.00 m.m.										
.079	688	23.8		76.2	23.8	82	68	15	5	89
.080	500	42.0		58.0	42.0	84	61	14	5	80
.081	548	20.8		79.2	20.8	80	67	20	3	90
.082	690	32.6		67.4	32.6	80				
Unsized Seed										
.079	318	27.7		72.3	27.7	85	54	13	4	71
.080	402	45.5		54.5	45.5	90	53	11	9	73
.081	374	41.1		58.9	41.1	90	55	13	5	73

28.35; at the number 3 setting, 24.44, and at the number 4 setting, 20.31.

In summarizing this work we must conclude that while it is possible to improve the quality of our seed to a great degree by proper clipper operation and gravity separation work, we are dependent, to a major degree, upon the type of segmenting that is accomplished. The segmenting process would appear to be the weak link in the chain and any further improvements to be made in increasing the quality and quantity of the segmented seed must, in the main, come from improved segmenting methods.

Table No. II.

A

Size m.m.	% of Total	Germination
+4.5	30.4	58
-4.5 +4.0	20.7	35
-4.0 +3.5	27.7	13
-3.5	21.2	5

B

Original Germ.	% Recovery	Screen Waste	Fan Waste	Final Germ.
45.0	87.6	10		60
33.5	85.7	5	1	52
42.5	86.7	4	3	58
43.0	81.9	15	14	58
43.0	74.8	8	7	57

TABLE NO. III

Gravity Table Setting	Spout No.	% Recovery	Germination				Spout No.	% Recovery	Germination			
			% Total	% Singles	% Doubles	Wt. per 100 Seed Balls			% Total	% Singles	% Doubles	Wt. per 100 Seed Balls
Lateral	1	15.79	94.00	66.49	33.51	1.02	1and2	35.60	95.11	74.03	25.87	1.01
Raise 1-1/2"	2	19.81	96.00	80.21	19.79	1.00	1 - 3	60.67	95.07	80.92	19.08	.97
	3	25.06	95.00	90.58	9.42	.89	1 - 4	81.76	91.70	84.90	15.10	.91
	4	21.09	82.00	96.36	3.64	.74	4and5	31.79	69.88	96.12	3.88	.65
Longitud.	5	10.70	46.00	95.65	4.35	.56	4 - 6	39.32	59.80	94.05	5.05	.60
Raise 1-7/8"	6	7.55	14.00	90.00	10.00	.50	5and6	18.24	32.77	93.32	6.68	.53
	1	11.79	97.50	72.31	27.69	.96	1and2	28.35	96.92	80.01	19.99	.99
Lateral	2	16.56	96.50	85.50	14.50	1.02	1 - 3	53.32	95.32	83.36	16.64	.98
Raise 1-1/2"	3	24.97	93.50	86.17	12.83	.96	1 - 4	76.15	89.67	86.39	13.61	.92
	4	22.83	76.50	93.46	6.54	.75	4and5	35.58	70.77	94.62	5.38	.69
Long.	5	12.74	60.50	96.69	3.31	.63	4 - 6	46.68	58.93	95.90	4.10	.63
Raise 2-1/4"	6	11.10	21.00			.50	5and6	22.46	44.72	98.12	1.88	.56
Lateral	1	9.57	95.50	71.93	28.27	1.17	1and2	24.44	96.41	79.52	20.48	1.08
Raise 1-1/2"	2	14.87	97.00	84.54	15.46	1.00	1 - 3	47.21	85.12	87.75	12.25	.99
	3	22.77	73.00	96.58	3.42	.81	1 - 4	70.75	79.09	90.54	9.46	.94
	4	23.54	78.00	96.15	3.85	.77	4and5	37.21	67.00	97.29	2.71	.75
Long.	5	13.67	67.00	99.25	.75	.74	4 - 6	52.79	54.31	98.09	1.91	.69
Raise 2-3/4"	6	15.58	24.00	100.00		.56	5and6	29.25	44.10	99.65	.35	.65
Lateral	1	7.62	97.00	69.59	30.41	1.11	1and2	20.31	95.13	75.96	24.04	1.08
Raise 1-1/2"	2	12.69	94.00	79.79	20.21	1.06	1 - 3	41.31	93.79	84.88	15.12	1.02
	3	21.00	92.50	93.51	6.49	.90	1 - 4	65.04	88.58	88.56	11.44	.97
Long.	4	23.73	79.50	94.97	5.03	.82	4and5	38.04	75.74	96.86	3.14	.79
Raise 3-1/4"	5	14.31	69.50	100.00	--	.77	4 - 6	58.69	54.02	97.97	2.03	.70
	6	20.65	14.00	100.00	--	.52	5and6	34.96	36.72	100.00	--	.64