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# Soybean Seed Size and Plant Performance

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We made a study using seed from three near-isogenic lines of soybeans differing genetically in average seed diameter to study relationships between seed size, physiological quality, and field performance. Seed from each line were sized into classes differing by 0.4mm (1/64-inch) in diameter. The size ranges are shown in Table 1.

In the laboratory, seed-size responses to different quality tests were evaluated. Seed of larger size classes exhibited significantly better viability than those of smaller size classes. Evaluations of vigor indicated that seed of the mean size class and larger did not differ significantly. However, seed more than two size classes smaller than the mean were significantly lower in vigor than the most vigorous seed of the lot regardless of the mean diameter or average weight/100 seed of the line. This can be visualized by observing the results presented in Table 2.

Results of the laboratory tests provided a good basis for predicting speed of emergence and stand establishment capabilities of seed of various size classes within each line. However, comparisons among lines were valid only when seed size was based upon its relation to seed of the mean size of each lot. This point may be clarified by looking at the data in Table 3. There were no differences in the vigor ratings of seed taken from the mean size class of each lot; however, when seed of 13/64-inch diameter from each lot are compared there was a great difference in their vigor ratings.

Growth factors studied in the field were seedling dry weight, leaflets per plant, plant stand, plant height, lodging and yield. A variety yield trial revealed the medium seeded variety had a slightly better yield capability than either the large or small seeded varieties.

The yields of the three lines when sub-divided into relative size classes are presented in Table 4. There were no significant differences in the yields of pure stands of the mean size class or among plots planted with seed 2/64-inch larger than the mean. On the other hand, pure stands of seed 2/64-inch smaller than the mean produced significantly less than the mean in the large and small lines. Also note that the seed from the small line that weighed 10 gm/100 seed yielded just as well as those from the large line which weighed 25gm/100 seed and more than those which weighed 14gm/100 seed. This is another indication that specific seed size assumes importance only when the size characteristics of the lot are described.

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Table 1. Seed size class distribution by percent and 100 seed weights for three lines of soybeans.

| CLASS Desig-nation | SEED DIAMETER (inch) | SEED DIAMETER (mm) | LARGE-SEEDED LINE Proportion of lot (%) | LARGE-SEEDED LINE 100-seed (g) | MEDIUM-SEEDED LINE Proportion of lot (%) | MEDIUM-SEEDED LINE 100-seed (g) | SMALL-SEEDED LINE Proportion of lot (%) | SMALL-SEEDED LINE 100-seed (g) |
|---|---|---|---|---|---|---|---|---|
| 21 | 21/64 | 8.33 | 0.50 | 30.42 | 00 | - | 00 | - |
| 20 | 20/64 | 7.94 | 3.00 | 28.53 | 00 | - | 00 | - |
| 19 | 19/64 | 7.54 | 17.43 | 25.65 | 00 | - | 00 | - |
| 18 | 18/64 | 7.14 | 26.82 | 22.68 | 1.15 | 20.65 | 00 | - |
| 17 | 17/64 | 6.75 | 22.78 | 19.25 | 8.60 | 17.98 | 0.33 | 18.37 |
| 16 | 16/64 | 6.35 | 15.78 | 17.38 | 27.55 | 14.85 | 4.41 | 15.25 |
| 15 | 15/64 | 5.95 | 7.93 | 14.88 | 33.67 | 13.52 | 17.73 | 12.83 |
| 14 | 14/64 | 5.56 | 3.80 | 11.45 | 20.21 | 11.12 | 37.04 | 10.17 |
| 13 | 13/64 | 5.16 | 1.23 | 7.77 | 6.05 | 9.45 | 26.12 | 8.50 |
| 12 | 12/64 | 4.76 | 0.50 | 4.22 | 2.01 | 7.50 | 10.98 | 6.88 |
| 11 | 11/64 | 4.37 | 0.19 | 3.43 | 0.55 | 5.07 | 2.74 | 5.28 |
| 10 | 10/64 | 3.97 | 0.05 | 2.52 | 0.18 | 3.55 | 0.59 | 3.88 |
| 9 | 9/64 | 3.57 | 00 | - | 0.04 | 2.43 | 0.07 | 2.70 |
| 8 | 8/64 | 3.18 | 00 | - | -- | - | 0.02 | 2.13 |
| Mean seed size class (diameter) | | | 17.21 | | 15.07 | | 13.69 | |
| Mean 100-seed wt. | | | 20.62 | | 13.62 | | 8.78 | |

Table 2. Evaluations of seed vigor of seed of all size classes of three lines of soybeans.

| Seed Size Class | Large-Seeded | | | Medium-Seeded | | | Small-Seeded | | |
|---|---|---|---|---|---|---|---|---|---|
| | First Count (%) | TZ Energy 1-3 (%) | Acc. Aging (%) | First Count (%) | TZ Energy 1-3 (%) | Acc. Aging (%) | First Count (%) | TZ Energy 1-3 (%) | Acc. Aging (%) |
| 21 | 91a[1] | 66a | 82.4a | - | - | - | - | - | - |
| 20 | 92a | 68a | 92.1a | - | - | - | - | - | - |
| 19 | 87a | 71a | 80.0a | - | - | - | - | - | - |
| 18 | 83ab | 64a | 82.4a | 93ab | 82ab | 93.6a | - | - | - |
| 17 | 80ab | 61ab | 78.4a[2] | 95a | 89a | 88.8a | 95a | 91a | 91.2ab |
| 16 | 69b | 47bc | 39.2b | 95a | 87ab | 92.0a | 96a | 93a | 91.8ab |
| 15 | 39c | 35cd | 31.2cd | 91ab | 85ab | 88.8a | 95a | 91a | 95.2a |
| 14 | 29c | 30d | 38.4bc | 83ab | 75b | 68.8b | 95a | 85a | 91.2ab |
| 13 | 15d | 15e | 22.4d | 79ab | 53c | 24.0c | 94a | 90a | 87.2ab |
| 12 | 5de | 5e | 16.8d | 29b | 11d | 14.4c | 90a | 84a | 66.4b |
| 11 | 2de | 3e | 2.4e | 9c | 12d | 12.0c | 84a | 71b | 36.0c |
| 10 | 13 | 0e | 0.0e | 4c | 1e | 0.0d | 47b | 42c | 16.0d |
| 9 | - | - | - | 0c | 0e | 0.0d | 19c | 19c | 0.0e |
| 8 | - | - | - | - | - | - | 8c | 6c | - |
| Composite | 85a | 69a | - | 89a | 81ab | - | 91a | 87a | - |
| C.V. | 16.24% | 23.32% | 17.46% | 14.05% | 12.81% | 14.52% | 12.17% | 11.92% | 13.17% |

[1]Means within each column not followed by the same letter are significantly different at the 1% level of probability as determined by DNMRT.

[2]Means underlined represent the mean size class of each line.

Table 3. Average seed vigor rating of seed from three lots of soybeans (mean size seed vs. 13/64-inch diameter).

| Seed Size | Vigor Rating[1] |
|---|---|
| Mean | |
| L = 17/64 | 265 a[2] |
| M = 15/64 | 287 a |
| S = 14/64 | 289 a |
| 13/64-inch | |
| L = ($\bar{x}$ - 4/64) | 63 c |
| M = ($\bar{x}$ - 2/64) | 169 b |
| S = ($\bar{x}$ - 1/64) | 290 a |

[1]Maximum = 300, based on 1st count, TZ energy 1-3, and accelerated aging.

[2]Means within a column followed by the same letter do not differ significantly at the 1% level of probability.

Table 4. Yield of soybeans grown from seed of the same relative diameter from the large-, medium-, and small-seeded lines of soybeans.

| Treatment | | | | Yield | |
|---|---|---|---|---|---|
| | | | | bu/A | kg/ha |
| Line x Relative Size Class | | | | | |
| | diameter (64th-in.) | relative to mean | Wt/100 (g) | | |
| Large-seeded | 19 | $\bar{x}$ + 2 | 25.65 | 38.5a | 2627 |
| | 17 | $\bar{x}$ | 19.25 | 40.0a | 2726 |
| | 15 | $\bar{x}$ - 2 | 14.88 | 34.2b | 2329 |
| Medium-seeded | 17 | $\bar{x}$ + 2 | 17.98 | 41.8a | 2853 |
| | 15 | $\bar{x}$ | 13.52 | 40.3a | 2750 |
| | 13 | $\bar{x}$ - 2 | 9.45 | 38.5a | 2625 |
| Small-seeded | 16 | $\bar{x}$ + 2 | 15.25 | 39.1a | 2663 |
| | 14 | $\bar{x}$ | 10.17 | 38.2a | 2603 |
| | 12 | $\bar{x}$ - 2 | 6.88 | 33.9b | 2310 |
| c.v. | 13.41% | | | | |

Means not followed by the same letter are different at the 1% level of probability as determined by the DNMRT.

We were also interested in the possibility of upgrading seed lots by processing. We compared yields of the composite lot of each of the three lines with seed remaining in the lot after the seed of lesser quality had been removed. The seed for this test were selected in the manner shown in Table 5. The results of this yield test are given in Table 6. As had been predicted two years earlier, there were no differences in yield. However, you should recall there were no significant differences in the overall physiological quality of the three seed lots evaluated.

The initial conclusions made from this study were as follow:

1. Seed of different dimensions and weights are normally distributed within each seed lot, but the range in size and the mean seed size varies from lot to lot.

2. Seed of the mean size and larger will be higher in both viability and vigor than those seed more than 2/64-inch smaller in diameter than the mean of the lot, when hand-threshed seed are compared.

3. The speed of emergence and initial stand establishment from the larger seed of a lot will be superior to that of smaller seed of the same lot when environmental conditions are near optimal.

4. The average vigor level of the seed within a lot has a greater influence on speed of emergence and initial stand establishment than does seed size per se.

5. Plants produced by smaller seed of a lot lodge less than plants produced from the larger seed.

6. No consistent relationship exists between seed of the same dimension or similar in weight/100 seed and yield. Rather, when a seed size-yield relationship exists, it is based upon seed size as related to the mean of the lot in question.

7. Removal of small, poor quality seed from a lot will not necessarily improve yield but will improve appearance of the seed.

This study is being continued but we believe these conclusions will hold. Now that we know more about seed size we will start investigating the sizing of soybean seed.

**Table 5. Comparative data of seed-size classes removed from the seed lots of the three lines in Experiment 5.**

| Lot Designation | Lot Description | Size Classes | | Proportion of Seed | | | |
|---|---|---|---|---|---|---|---|
| | | | | Removed from the lot | | | Remaining in lot (%) |
| | | Removed | Remaining | Smallest seed (%) | Largest seed (%) | Total (%) | |
| | Large-seeded line: | | | | | | |
| A | Check | none | 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 | 0.00 | 0.00 | 0.00 | 100.00 |
| B | 3 smallest | 10, 11, 12 | 13, 14, 15, 16, 17, 18, 19, 20 | 0.74 | 0.00 | 0.74 | 99.26 |
| C | 2 largest | 20, 21 | 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 | 0.00 | 3.50 | 3.50 | 96.50 |
| D | 3 smallest & 2 largest | 10, 11, 12, 20, 21 | 13, 14, 15, 16, 17, 18, 19 | 0.74 | 3.50 | 4.24 | 95.76 |
| E | 6 smallest & 2 largest | 10, 11, 12, 13, 14, 15, 20, 21 | 16, 17, 18, 19 | 13.70 | 3.50 | 17.20 | 82.80 |
| | Medium-seeded line: | | | | | | |
| A | Check | none | 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 | 0.00 | 0.00 | 0.00 | 100.00 |
| B | 3 smallest | 9, 10, 11 | 12, 13, 14, 15, 16, 17, 18 | 0.77 | 0.00 | 0.77 | 99.23 |
| C | 2 largest | 17, 18 | 9, 10, 11, 12, 13, 14, 15, 16 | 0.00 | 9.75 | 9.75 | 90.25 |
| D | 3 smallest & 2 largest | 9, 10, 11, 17, 18 | 12, 13, 14, 15, 16 | 0.77 | 9.75 | 10.52 | 89.48 |
| E | 5 smallest & 2 largest | 9, 10, 11, 12, 13, 17, 18 | 14, 15, 16 | 8.83 | 9.75 | 18.58 | 81.42 |
| | Small-seeded line: | | | | | | |
| A | Check | none | 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 | 0.00 | 0.00 | 0.00 | 100.00 |
| B | 3 smallest | 8, 9, 10 | 11, 12, 13, 14, 15, 16, 17 | 0.68 | 0.00 | 0.68 | 99.32 |
| C | 2 largest | 16, 17 | 8, 9, 10, 11, 12, 13, 14, 15 | 0.00 | 4.74 | 4.74 | 95.26 |
| D | 3 smallest & 2 largest | 8, 9, 10, 16, 17 | 11, 12, 13, 14, 15 | 0.68 | 4.74 | 5.42 | 94.58 |
| E | 5 smallest & 2 largest | 8, 9, 10, 11, 12, 16, 17 | 13, 14, 15 | 14.40 | 4.74 | 19.14 | 80.86 |

Table 6. Yields of soybeans grown from seed lots formed by removal of selected seed size classes of the large-, medium-, and small-seeded lines.

| Treatments | Yield | |
|---|---|---|
| | Bu/A | Kg/ha |
| Lots: Size classes removed | | |
| A (check - none) | 43.2 a | 2944 |
| B (3 smallest) | 42.7 a | 2912 |
| C (2 largest) | 46.6 a | 3168 |
| D (3 smallest & 2 largest) | 44.5 a | 3035 |
| E (5 or 6 smallest & 2 largest) | 43.3 a | 2955 |
| c. v. 12.20% | | |

Means not followed by the same letter are significantly different at the 1% level of probability as determined by DNMRT.