SEED QUALITY AND PERFORMANCE RELATIONSHIPS

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A uniform stand of vigorous seedlings from a single (first) planting is essential to an economically successful seed production program. Each year seedsmen replant at least part of their over-all acreage because of unsatisfactory stands. Replanting adds much to the costs of production of seed, directly as added costs for additional seed, land preparation, herbicide application, labor, etc., and indirectly because of disruption of the timely scheduling of other critical operations which are important for successful seed production operations.

Even though stand failures can result from any one or a combination of factors - poor seedbed preparation, low temperatures, unfavorable moisture, soil microorganisms and chemical injury - LOW QUALITY SEED are probably a major contributing factor to many stand failures. Seed of low quality are very susceptible to adverse conditions and stresses in the environment of the seedbed, and they usually produce an acceptable stand only under the most favorable conditions.

The general quality of some seed, cottonseed for example, is often relatively low as compared to seed quality of most kinds of seeds. This situation leads to a dependence upon complex and heavy applications of seed treatments to compensate for low seed quality. And in many other cases, soybeans for example, seed quality is not uniformly high from year to year due to either severe weathering or to mechanical damage.

Indeed low quality seed fail to emerge from the seedbed under the wide range of conditions often prevalent at planting. Therefore, the seedsman is confronted with the dilemma of deciding whether his "STAND" is in fact a stand or whether replanting will prove economically advantageous. In many instances a seedsman is likely to "GO" with a seed field which is actually marginal or sub-optimal in its potential to produce maximum yields.

And even assuming that the growing conditions are such that the weaker, poorer quality seeds do emerge, even though at a slower rate, their potential to perform and compete is questionable. True, the surviving stand may appear adequate, but it is rather doubtful if the entire population is equally competitive.

In studying the effect of seed quality on response-reactions of seeds, hybrid sorghum seed were artificially aged for 3, 5, 7, and 11

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days, which produced vigor levels (quality ratings) of high (3 days) medium (5 days), low (7 days), and very low (11 days), respectively. A fifth treatment consisted of mixture and the check (zero days or non-aged seed) and seed of the lowest vigor level, L_4 (aged for 11 days at 42°C - 100% r.h.).

Results showed that seed vigor decreased as measured by stand establishment and percent panicle exsertion, and plant height differed more at 23 days than at 90 days (table 1).

Table 1. Response-reactions of different vigor levels of sorghum

Vigor Levels	Std. Germ. (%)	Stand Estab. (%)	Avg. Plt. Ht. (mm) 23 days	Avg. Plt. Ht. (mm) 90 days	Panicle Exsertion (%)
L_0	97.0	83.3	448	924	45.8
L_1	96.0	85.0	429	948	42.3
L_2	95.5	91.3	421	911	43.7
L_3	95.0	81.0	400	932	21.3
L_4	86.0	71.3	347	907	20.0
L_5 (0+11)	91.0	----	392	897	24.5

The adverse effects of low seed vigor was also observed on field performance as measured by tillering and yield (Table 2). The composite treatment consisting of a seed mixture of the non-aged seed and the lowest quality seed performed more poorly than any of the other treatments as far as yield was concerned.

Table 2. Yield responses of different vigor levels of sorghum

Vigor Levels	No. Tillers Productive	No. Tillers Unproductive	No. Tillers Total	Tiller Yield (gm)	Total Yield Kg/treat
L_0	139a	59a	198	225.2a	4.5
L_1	125ab	50abc	175	187.6ab	4.2
L_2	100bc	28d	128	171.0abc	4.3
L_3	72c	41abcd	113	104.6d	4.1
L_4	67c	51ab	118	145.9bcd	3.9
L_5	60c	54abcd	114	127.3cd	3.8

Furthermore, seventeen soybean seed lots were evaluated by the standard germination test, the accelerated aging technique and a cold test procedure. Although somewhat variable, yield data showed that two lots, nos. 3 & 4 in which more than 50% of the seeds were dead, yielded extremely low. Lot number 5, a hand harvested lot gave highest yield of 47 bushels per acre (Table 3).

Table 3. Performance evaluation of 17 soybeans seed lots

Lot No.	Std. Nor. %	Germ. Abn. %	Test Dead %	Accel. Test %	Aging Abn. %	Test Dead %	Cold Test %	Yield Bu/a. %
1	75.0	9.5	15.5	54.5	18.0	27.5	10	42.03
2	58.0	22.0	20.0	53.5	24.5	22.0	26	42.17
3	20.5	11.5	68.0	8.5	4.0	87.5	0	8.46
4	25.5	10.5	64.0	8.5	8.5	83.0	0	20.09
5	89.5	7.5	3.0	84.0	1.5	14.5	96	47.10
6	82.5	12.0	5.5	87.0	8.5	4.5	88	31.30
7	80.5	13.0	6.5	89.5	7.5	3.0	88	36.97
8	95.5	4.0	0.5	95.5	3.0	1.5	94	33.65
9	93.5	3.0	3.5	93.0	5.0	2.0	82	37.40
10	92.0	7.0	1.0	91.5	6.0	2.5	80	36.58
11	94.5	4.5	1.0	89.0	6.0	5.0	82	39.42
12	87.0	11.5	1.5	83.5	14.0	3.0	68	27.11
13	94.5	4.5	1.0	95.5	4.5	0.0	88	43.68
14	90.5	8.0	1.5	93.5	5.0	1.5	94	42.24
15	85.0	12.5	2.5	80.5	14.5	5.0	94	36.67
16	85.5	13.0	1.5	83.0	13.0	4.0	94	38.77
17	95.5	3.5	1.0	94.5	3.0	2.5	94	45.61

Considerable loss in seed quality stems directly from mechanical injury. Seed corn with four damage levels, 11.5, 17.0, 23.0, and 40.0 percent, were evaluated for their response-reactions. The two lots with highest damage were slower growing in early plant performance stages (20 days); however, at 40 days this difference was negligible (Table 4).

Table 4. Average plant height of four lots of seed corn with different degrees of mechanical damage at two intervals after planting.

Treatments (% damage)	Average plant height in cms. 20 days old	40 days old
11.5	59.08 ab	164.88
17.0	57.65 ab	162.90
23.0	52.60 c	156.57
40.0	51.83 c	155.00

Although the yield reduction at the highest injury level was 15%, it was statistically non-significant. However, shelling percentage did show a significant reduction at the highest level of mechanical injury (Table 5).

Table 5. Effect of mechanical damage on the germination, total field emergence, stand establishment and yield of four lots of seed corn.

Damage Level %	Germ. %	Field Emerg. %	Stand Estab. %	Yield Kg/ha	Yield Reduction %	Shelling %
11.7	98.0	88.75	86.50	1774.08	-----	70.69a
17.0	95.0	89.38	85.80	1717.60	3.19	70.12a
23.0	95.0	85.75	79.15	1705.98	3.84	68.45a
40.0	95.5	85.63	78.30	1599.66	15.47	62.80b

Various investigations have been conducted concerning the effect of seed size, a definite seed quality parameter, upon seed and plant performance. Work with some vegetable seed has been enlightening. Turnip seed were sized into 4 groups.

Large - seed screened over a 1/15" round hole

$Medium_1$ - seed screened thru a 1/15" and over a 1/17" round hole

$Medium_2$ - seed screened thru a 1/17" and over a 1/19" round hole

Small - seed screened thru a 1/19" round hole

Although germination differed little selected response-reactions declined as seed size declined (Table 6).

Table 6. Response-reactions of sized turnip seed

Seed Size	Std. Germ. %	Field Emerg. %	30-day Seedling Fresh Wt. (gm)	36-day Seedling Dry Wt. (gm)	Leaf Count (15 Plts) 36 da	50 da	80 da
L	99.9	86.8	35.4	4.3	88	128	169
M_1	99.3	80.2	21.0	2.7	82	110	155
M_2	99.0	76.2	15.5	2.0	80	108	138
S	96.0	72.7	15.1	1.8	79	107	137

Yield components declined consistently as seed size declined (Table 7).

Cabbage seed were sized into size groups as follows:

Large - seed screened over a 1/13" round hole

Medium - seed screened thru a 1/13" and over a 1/15" round hole

Small - seed screened thru a 1/15" and over 1/17" round hole

Seed germination was affected very little due to size differences; however, other response-reactions decreased considerably as seed size declined (Table 8).

Table 7. Yield components from sized turnip seed

Seed Size	Leaf Fresh Wt. gm/plt		Root Fresh Wt. gm/plt			Mean Root Size (mm)					
						80		105		135	
	80	105	80	105	135	W	L	W	L	W	L
L	63	56	34	72	61	37	60	51	67	41	59
M_1	52	48	26	58	59	31	53	49	60	45	52
M_2	45	47	24	57	58	30	42	31	52	43	53
S	43	46	23	48	53	29	34	37	35	44	44

Table 8. Response-reactions of sized cabbage seed

Seed Size	Std. Germ. (%)	Field Emerg. (%)	36-day Seedling Fresh Wt. (gm)	36-day Seedling Dry Wt. (gm)	Leaf Count 10 plt. avg.		
					36	50	80
L	93	88	13	1.8	38	54	82
M	94	79	8	1.1	31	47	73
S	89	78	6	0.7	30	46	72

In evaluating seed quality of cottonseed based upon specific gravity, seed of the lowest specific gravity below .88, performed significantly inferior to seed of higher specific gravity. Due to the reduced plant population, bolls per plant were not reduced (Table 9).

Table 9. Response-reactions of different gravity groups of Coker 201 cottonseed.

Specific Gravity Group	Std. Germ. (%)	Field Emerg. (%)	4-wk. Plant ht. cm.	Dry Wt. per plt. (gm)	Bolls per plt. (No.)
Composite	54.67b	64.50a	16.23a	.94	10.62ab
0.88	38.00c	33.25b	12.78b	.77b	11.62a
0.88-0.93	50.33b	60.25a	15.03a	.82ab	8.50ab
0.93-0.98	67.33a	65.75a	15.94a	.96a	7.87b
0.98-1.03	55.00b	65.00a	15.93a	.86ab	8.37a

Continuing emphasis is being devoted to evaluating seed and seedling vigor and determining its influence upon growth parameters and final yield. Current research is directed towards investigating the nature and sequence of deterioration (seed quality) in many kinds of seed. It is desirable to determine the influence of seed deterioration on germination, emergence, growth, development, and reproduction of seeds. Ultimately, it would have significant impact upon the seed industry to establish a maximum degree of deterioration (quality rating or index) that can be sustained by seeds without significantly affecting their germination, emergence, and subsequent plant performance.