Test Weight and Your Next Wheat Crop:
A Fact Sheet

Will low test weight wheat be suitable for use this fall?
While test weights of 56 pounds per bushel are most desirable, lighter test weights may be an acceptable alternative when heavier seed of desirable varieties is not available.

The effect of test weight on emergence, vigor, and yield potential will vary from year to year. When there is stress on the seedlings or young plants in the fall from freeze or drought or some other factor, the effect of higher test weight seed is often greatest.

The charts below show the results of two tests done at K-State's Agronomy North Farm in 1950 by H.H. Laude, professor of agronomy, with seed provided by Frank Bieberly, Extension agronomist.

Wheat Seed Quality: Pawnee variety		
	Heavy seed	Light seed
Test weight	59.5	44.1
Germination	91%	95%
Viable seeds/lb	15,800	31,900
Pounds planted/acre	83.5	92.2
Viable seeds/acre	1,320,000	2,940,000
Emergence (% of viable seeds)	60.8%	28.4%
Days to emergence	21	27
Heads/plant	3.01	2.68
Size of heads (grams)	0.499	0.479
Test weight of final crop (lbs/bu)	60.8	60.8
Yield of final crop (bu/acre)	44.3	39.3

Wheat Seed Quality: Wichita variety		
	Heavy seed	Light seed
Test weight	62.4	53.1
Germination	92%	86%
Viable seeds/lb	12,000	19,200
Pounds planted/acre	88.2	77.2
Viable seeds/acre	1,060,000	1,480,000
Emergence (% of viable seeds)	68.0%	48.4%
Days to emergence	21	25
Heads/plant	2.91	2.78
Size of heads (grams)	0.658	0.618
Test weight of final crop (lbs/bu)	61.9	62.0
Yield of final crop (bu/acre)	50	45

Several conclusions can be drawn from this study:

- Test weight had no effect on germination.
- Higher test weight seed had 20-40% improved field emergence.
- Higher test weight seed emerged 4-6 days sooner.
- Higher test weight seed resulted in about a 5-bushel yield increase.
- Test weight of the seed had no effect on the final test weight of the subsequent crop.

Generally, each three pounds per bushel in test weight signifies one to two bushels per acre in yield. Yields and vigor are likely to be affected at test weights below 54-56 pounds per bushel. Below that level, the plants are likely to have more problems in the fall and in surviving the winter.

How can I manage the risk of low-test-weight seed most effectively?

Here are a few things to keep in mind about low-test-weight seed:

- Producers planting low-test-weight seed should be cautious not to plant the seed too deeply, since seedling vigor will be below average.
- Certified seed with a sub-standard test weight still meets the KCIA standard for germination. Using certified seed of a variety adapted to the planting area is the best quality decision that can be made this year.
- Plant varieties that you are able to manage.
    - If you live in an area that is affected by soilborne mosaic disease, then planting a variety without resistance to this disease will greatly increase your risk.
    - Unless you are planning to graze out, plant on or after the Hessian fly free date.
    - Some research suggests that it is good practice to apply a low rate of fungicide in the early spring to control powdery mildew, then to follow with a full rate at the flag leaf stage to control foliar diseases. If you plant a variety with limited resistance to leaf rust or stripe rust, be prepared to monitor your fields to manage these diseases.

Where can I find more useful information?

All of these links are available on the KCIA web site at www.kscrop.org/links.aspx

K-State Research and Extension http://www.oznet.ksu.edu
Kansas Crop Performance Tests http://kscroptests.agron.ksu.edu/
KSU Department of Plant Pathology Extension (includes Wheat Variety Disease and Insect Ratings) http://www.plantpath.k-state.edu/DesktopDefault.aspx?tabid=49
KSU Department of Agronomy Extension (includes weekly Agronomy eUpdates) http://www.agronomy.k-state.edu/DesktopDefault.aspx?tabid=49

Tips for planting low-test-weight wheat

Producers who are planting wheat seed with a test weight below 55 pounds per bushel this season will want to take certain steps to help increase the chances of getting a good stand. Low-test-weight seed usually germinates well, but seedlings tend to have lower vigor than seedlings from seed with higher test weights. Therefore, producers should take special care to try to get a good, healthy stand.

Drill speed. Using a drill speed of 5 mph will help ensure that the seed is placed down in the seed slot, and that the seed slice is closed and firmed properly, making for good seed-soil contact. Getting good seed-soil contact will help the seedlings develop a good primary and secondary root system. Also, when drill speeds are too fast, the openers tend to “ride up” at times, resulting in a planting depth that is shallower than intended.

Seeding depth. All wheat should be planted at the proper depth for best stands. But it is especially important that low-test-weight seed is not planted too deeply, since this seed has low emergence vigor to begin with. It is equally important not to plant too shallowly. Shallow-planted wheat often has more difficulty establishing a good root system in the fall than wheat planted at the proper depth, and this can be an even greater problem when using low-test-weight seed. Plant low-test-weight seed 1 to 1.5 inches deep.

Seeding rates. The lower the test weight, the more seeds there are per pound. Producers who use a planting rate based on the number of pounds per acre should not adjust their seeding rate when planting low-test-weight seed. They will end up planting more seeds per acre, but emergence is often somewhat lower with low-test-weight seed, so the stand should come out about normal.

Seed treatments. Fungicide seed treatments are advisable if seed is infected with a disease such as loose smut, common bunt, scab, or black point; if seeding dates are unusually early or late; and in no-till situations. It may also be a good idea to use a fungicide seed treatment on low-test-weight seed even if it doesn’t meet one of those criteria, simply to protect the seed against seed-borne diseases, seed rots, and seedling blights that may reduce vigor.

Producers should make every effort to have their seed cleaned as thoroughly as possible to remove scabby kernels and shriveled seed. This will help increase the test weight and improve emergence and seedling vigor.

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Effect of Seed Size and Density on Winter Wheat Performance

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Winter wheat is the most important crop in Kansas, seeded annually on approximately 12-13 million acres. Any production practice that influences yield of this crop is important. Little work has been done in Kansas on selection of wheat seed or on the influence of seed quality on the resulting crop.

Wheat Seed Quality

The majority (ca. 85%) of wheat seed used in Kansas is "bin run" or not of a class of certified seed. Wheat certification standards ensure genetic purity, varietal identity, freedom from noxious weeds, minimal quantities of objectionable weeds and other crop seed, and a germination percentage of at least 85%. However, present certification standards do not address quality characteristics related to seed vigor. Seed quality, as used in this report, relates to those factors important in emergence and productivity.

Previous research in Kansas and other states has shown that crop yields are partially dependent on the characteristics of the seed planted. However, most producers have been reluctant to accept evaluation of seed quality as an important management practice. As a result of the development of a better organized and dependable seed industry, Kansas currently has the capability of providing seed of improved quality for Kansas producers.

Research was initiated at the Colby Experiment Station in 1979 to evaluate yield and performance of wheat grown from seed of varying size and density.

AGRICULTURAL EXPERIMENT STATION
Kansas State University, Manhattan
John O. Dunbar, Director

Procedure

Foundation seed grown at the Colby Experiment Station was used for the research in this report. Three varieties of winter wheat were used. Tests at Colby included Newton and Eagle in 1980, 1981, 1982 and 1983, plus Vona in 1982 and 1983. All three varieties were tested at Hays in 1982.

Seeds were divided into the following seedlot fractions:

Control—unselected seedlot
Small—smallest seed, hand-screened
Large—largest seed, hand-screened
Light—lightest density, gravity table
Heavy—heaviest density seed, gravity table

Each of the four separated variants represented less than 10% of the total seedlot. Screen size varied due to seed size of each variety. Seed produced in 1979 was used for the test years 1980 and 1981, and 1981-produced seed was used for the test years 1982 and 1983. The year refers to year of grain harvest.

All fields were planted in four-row plots, 10 feet long with 14" row spacing at Colby and 12" spacing at Hays. Seeding rate was constant at 850 seeds per plot, or approximately 45 lbs./acre for the control seedlots. All planting was done with a hoe-drill at normal seeding time. Each seedlot was seeded at two depths, normal and deeper to simulate more unfavorable planting conditions. Deep-seeded plots had approximately one inch more soil coverage than normally seeded plots.

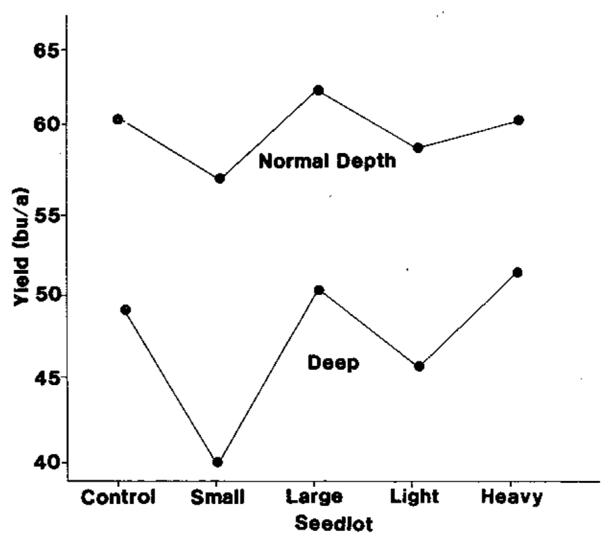

Figure 1. Influence of seedlots and planting depth on yield of winter wheat.

Table 1. Seed characteristics of three varieties of winter wheat.

Variety and Seedlot	Test Weight (bu./a)	Gm/1000 Seeds	Protein mg/g	Protein mg/seed	Microamp Value	Microamp Value/ G/1000 S.
			1980 and 1981 Crop			
Newton						
Control	60.5	32.5	121	3.9	___	___
Small	58.7	23.8	119	2.8	___	___
Large	59.6	39.5	124	4.9	___	___
Light	57.4	25.6	126	3.2	___	___
Heavy	61.3	38.3	120	4.6	___	___
Eagle						
Control	58.4	33.2	131	4.3	___	___
Small	57.6	26.4	132	3.5	___	___
Large	58.8	33.0	136	4.5	___	___
Light	58.0	27.7	130	3.6	___	___
Heavy	60.2	38.0	124	4.7		___
			1982 and 1983 Crop			
Newton						
Control	60.8	45.2	136	6.14	40.03	.89
Small	58.6	19.2	131	2.50	45.34	2.36
Large	61.6	48.8	142	6.93	78.40	1.68
Light	59.7	31.6	139	4.39	60.91	1.93
Heavy	63.4	40.0	131	5.24	55.34	1.38
Vona						
Control	59.9	29.6	126	3.73	34.67	1.17
Small	56.5	16.4	134	2.20	36.72	2.24
Large	60.8	37.2	138	5.13	54.75	1.47
Light	54.2	21.6	131	2.83	55.10	2.55
Heavy	62.7	34.0	143	4.86	54.24	1.60
Eagle						
Control	59.3	37.6	159	5.98	53.97	1.43
Small	58.7	19.2	142	2.73	41.00	2.14
Large	61.5	43.6	161	7.02	77.41	1.78
Light	59.6	33.2	165	5.48	54.45	1.64
Heavy	63.2	40.4	153	6.18	60.75	1.50

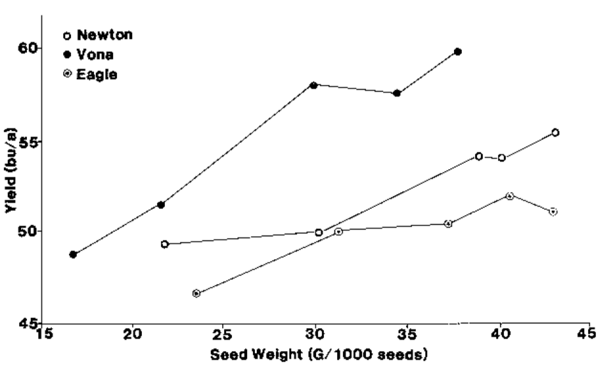

Figure 2. Influence of G/1000 seeds on yield of three winter wheat varieties.

Table 2. Overall averages for yield, test weight and thousand seed weight.*

Seedlot	Yield (bu./a)	Test Weight	G/1000 Seeds
Control	53.59	59.78	36.70
Small	48.10	58.16	21.42
Large	54.42	60.46	41.50
Light	50.28	57.76	28.62
Heavy	53.99	62.16	38.40

*Averages for all varieties, years, seeding depths, and locations of tests.

Table 3. Seedlot variant correlations, seed characteristics with yield.

Seed Characteristic	1980 Yield	1981 Yield	1982 Yield (Colby)	1982 Yield (Hays)	1983 Yield
Test Weight	.63**	.33	.86*	.79*	.65*
G/1000 Seed	.51**	.47	.96**	.99**	.74**
Protein (mg/g)	-.61**	-.39	-.54**	.30	.12
Protein (mg/seed)	.10	.23	.03	.59**	.20
Microamp	____	____	-.13	.23	.53*
Microamp/ G/1000 Seed	____	____	-.32	-.67**	-.57*

*significant at .05   *significant at .01

Results

Field emergence counts tended to favor the normal depth of planting; however, the differences generally were not significant. Greater emergence differences were observed with the small and light seed and smaller differences with the larger and heavier seed.

Yields were influenced by depth of planting and the seedlots used (Figure 1). The greatest effect on yield was a reduction of 9 bu./acre with small seed in deep-seeded plots. Large seed provided the highest yields at the normal depth of planting and heavy seed provided highest yields at the deep planting.

Figure 2 shows the relationship of yield and seed weight for the three varieties studied. Vona yields were most influenced by seed size (as measured by seed weight, g/1000 seeds), and Eagle the least influenced. Vona also had the smallest seed of the varieties studied. Test weights and gm/1000 seeds for all seedlots of the three varieties are shown in Table 1.

Table 2 shows overall averages for yield, test weight and seed size of the five seedlots. Yield appears to be affected more by grams/1000 seeds than by test weight. This relationship is supported by correlation values obtained from each of the years of this study (Table 3). Grams/1000 seeds had a closer relationship with yield in 4 of the 5 location years studied than did test weight.

The various seedlots had relatively small effects on date of heading, height, number of seed-bearing tillers, lodging, test weight, protein of grain havested, and kernel size of grain harvested.

In 1983, an instrument[1] capable of measuring seed germination and vigor was obtained to evaluate seed differences. Seed used for the 1982 and 1983 crops was evaluated to determine if seed vigor could indeed be measured and if it would correlate with field yield results. The instrument works by measuring electrical conductivity (in microamps) of seed leachate. Higher readings indicate less seed membrane integrity and increased ionic leakage from the seed, which results in reduced germination and vigor. Lower readings are associated with high germination and vigor. Seed size has an influence on the microamp reading due to quantity of mass in the seed (Table 1). When the effect of seed size was removed, microamp readings were strongly associated with yield (Table 3). In this study, percent seed protein did not appear to be as important as the amount of protein per seed, again indicating importance of seed size.

[1]Agri-Sciences Model A5610 Seed Analyzer supplied by Agri-Sciences, Ann Arbor, Michigan.

Conclusions

Winter wheat yields are influenced by the quality and characteristics of the seed planted. Seed size (grams/1000 seeds) appears to be the most important single characteristic but test weight and protein per seed are also important. Yield differences of 10-15% were measured, with the lowest yields resulting from deep seeding depths. Small and/or light seed always yielded less than the control, heavy or large seed. An electronic seed analyzer appears to be capable of predicting relative performance of seedlots. Attention in selecting seed can help assure maximum yield of wheat. High-quality seed can be selected at present with little or no increase in seed costs.

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