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Effect of Seed Size and Density on Winter Wheat Performance (1984)

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Effect of Seed Size and Density on Winter Wheat Performance

Larry D. Robertson

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
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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.

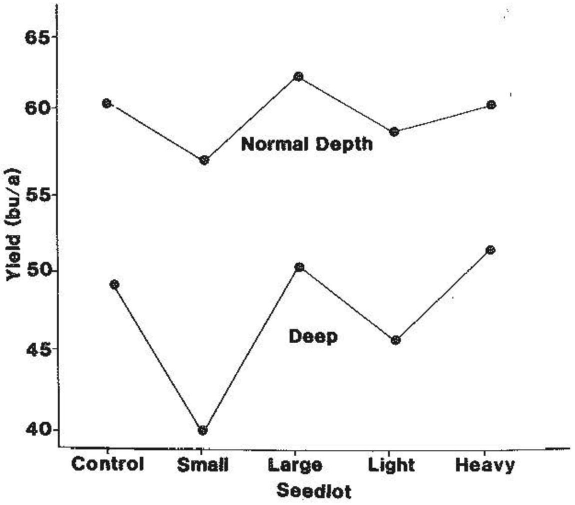

Figure 1. Influence of seedlots and planting depth on yield of winter wheat.

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

Variety and Seedlot	Test Weight (bu./a)	Gm/1000 Seeds	Protein		Microamp Value	Microamp Value/ G/1000 S.
			mg/g	mg/seed		
			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

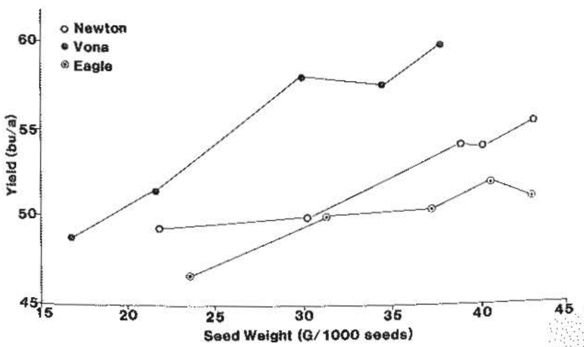

Figure 2. Influence of G/1000 seeds on yield of three winter wheat varieties.

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.

Contribution 84-326-S, Colby Branch Experiment Station

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