Factors affecting performance of different pedigreed seedlots of Harrington barley and Katepwa wheat.

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Introduction

Previous investigations have shown that seedlots obtained from different sources can exibit significantly different levels of performance (DasGupta and Austenson, 1973; McFadden, 1963; Rossnagel and Baker,1986). The cause(s) of this differential performance has been attributed to differences in seed vigor (DasGupta and Austenson, 1973). Some of the factors thought to affect seed vigor include seed size (Lafond and Baker, 1986), rate of germination(Boyd et al., 1971 and various chemical constituents of the seed (McFadden, 1963).

The present study was conducted to compare yield potentials of barley and wheat seedlots collected from pedigreed seed growers across the Prairies. An attempt was made to determine what seed quality factors affect performance.

In addition, an evaluation of a new method of measuring seed vigor was carried out. The procedure, called the radiation stress test, was developed at the Atomic Energy Commission in Pinawa, Manitoba by Dr. Steve Sheppard.

Materials and Methods

Forty samples of spring barley (Hordeum vulgare L. cult. Harrington) and fifty samples of hard red spring wheat (Triticum aestivum L. cult. Katepwa) were obtained from pedigreed seed growers across the Prairies in 1987. Prior to seeding, the lots were screened through a 6/64" screen in an attempt to reduce the effect of seed size.

Yield trials for barley were conducted at Saskatoon and Indian Head, Saskatchewan in 1987.Wheat yield trials were grown at Saskatoon and Watrous, Saskatchewan. At the Saskatoon location, the experimental design was a randomized complete block with 8 replications. At the Indian Head and Watrous locations, the design was a randomized complete block with 4 replications. Plots in the yield trials consisted of 5 rows approximately 12 feet long and 4 rows approximately 12 feet long for the barley and wheat, respectively.

In the Saskatoon laboratory, seed characteristics including test weight, kernel weight, germination rate, hardness(wheat only), and density were measured on each seedlot. Density was determined using method no.1 as described by Pawlowski (1963). Germination percentages for the barley and wheat were determined by the Plant Health and Quarantine Division of Agriculture Canada.

Measurements of seed conductivity and the parameters of the radiation stress test (RST) were carried out by Dr. Steve Sheppard at the Atomic Energy Commission in Pinawa, Manitoba. The parameters calculated in connection with the RST were radgerm (radiation germination), radsens (radiation sensitivity), LD25 (lethal dose, 25% kill) and LD50 (lethal dose, 50% kill). Radgerm and radsens were determined for the barley whereas radgerm, radsens, LD25 and LD50 were calculated for the wheat lots.

Radgerm was determined by exposing the barley and wheat seedlots to 7.5 K Gy and 10 K Gy of gamma radiation, respectively and then determining their germination percentage. Radsens was calculated by dividing the radiation germination count obtained for each lot by its standard germination percentage. LD25 and LD50 values reflect the dose of gamma radiation required to kill 25% and 50% of the seed respectively.

Data Analysis

Correlations between each pair of seed characteristics and between yield and each seed characteristic were used to determine which seed characteristic(s) was most closely associated with yield potential.

Covariance analysis (Snedecor and Cochran, 1967) in which variation among mean yields of seedlots was partitioned into a portion related to seed characteristics and a portion not explained by differences in seed characteristics, was carried out for yields combined over two locations.

Results and Discussion

Correlations (Tables 1 and 2) indicate that attempts to reduce the effect of seed size by screening were largely successful. Seed size, as measured by kernel weight, was correlated with yield only for wheat at the Saskatoon site.

Of the seed quality factors examined in barley, density was the only characteristic which was significantly correlated wuth yield at both sites and with the yield from a combined analysis (Table 1). Germination rate and percentage, test weight, radgerm and radsens gave significant correlations with yields at one of the two sites and with the yield from the combined analysis.

Table 1. Correlations between yield and various seed characteristics of seedlots of Harrington barley, 1987.

Variable	Site		
	Saskatoon	Indian Head	Combined
Conductivity	-0.16	-0.10	-0.17
Germination rate	0.36*	0.28	0.38*
Germination percentage	0.37*	0.24	0.38*
Test weight	0.30*	0.24	0.34*
Density	0.30*	0.36*	0.40**
Kernel weight	0.14	0.13	0.23
Radiation germination	0.21	0.36*	0.32*
Radiation sensitivity	0.17	0.36*	0.39*

*,** significant correlation at the 5% and 1% levels,respectively

In wheat, none of the seed characteristics gave significant correlations with yield at both sites. Test weight, LD25 and radgerm were significantly correlated with yield at the Saskatoon site and with yield from a combined analysis (Table 2).

Table 2. Correlations between yield and various seed characteristics of seedlots of Katepwa wheat, 1987.

Variable	Site		
	Saskatoon	Watrous	Combined
Conductivity	0.11	-0.03	0.04
Hardness	-0.24	-0.20	-0.28*
Germination rate	0.03	0.13	0.12
Germination percentage	0.39**	0.05	0.26
Test weight	0.39**	0.10	0.30*
Density	0.18	0.18	0.24
Kernel weight	0.33*	0.05	0.23
LD25(rad)	0.28*	0.25	0.35*
LD50(rad)	0.05	0.08	0.08
Radiation germination	0.29*	0.21	0.32*
Radiation sensitivity	0.11	0.20	0.21

*,**- significant correlation at the 5% and 1% levels, respective]

Results of the analysis of covariance indicated that a significant portion of the variation in yield performance of seedlots of both barley and wheat could be explained by seed characteristics (Tables 3 and 4). This conclusion is based on the occurence of significant linear regressions of yield in barley and wheat on density and test weight, respectively.

Table 3. Analysis of covariance of grain yield (g/plot) with seed density of Harrington barley grown in eight replications at Saskatoon and four replcations at Indian Head.

Source of variation	df	MS
Replications	11	1465667**
Seedlots		
Regression on density	1	136020**
Deviations	38	19954
Error	429	19854

** - significant at the 1% level

Table 4. Analysis of covariance of grain yield (g/plot) with test weight of 50 seedlots of Katepwa wheat grown in eight replications at Saskatoon and four replications at Watrous.

Source of variation	df	MS
Replications	11	365239**
Seedlots		
Regression on test wt.	1	39887*
Deviations	48	8402
Error	539	6614

*,** - significant at the 5% and 1% levels, respectively

Of the seed factors examined in barley, yield performance was primarily related to the density of the seed. Such a result indicates that cleaning practices, such as the use of a gravity table, designed to increase the density of a seedlot, may be effective in increasing the potential performance of pedigreed barley.

In this study, test weight appeared to be the most important seed quality characteristic determining yield in wheat. Practices designed to minimize losses in test weight, or cleaning procedures to increase the test weight of seed, may lead to a seed product with potential for greater yield.

An evaluation of the RST indicates that none of the parameters measured by the RST offer a substantially better predictor of yield potential, in barley or wheat, than does standard germination, the measure of seed quality currently used by the seed industry.

In barley, neither radgerm or radsens give a better prediction of yield potential than does germination percentage.

In wheat, the evidence is inconclusive as to whether LD25 or radgerm offer a better estimate of seed quality than does germination percentage. Clearly, LD50 and radsens do not offer good estimates of seed quality in wheat.

At this point, there is no clear evidence to suggest that seed from any particular geographic area outperforms seed from any other.

Future Research

Yield trials will be carried out again in 1988. Seed quality factors currently under study include protein, oil and various mineral contents. Malt analysis (barley only), viscosity measurements (barley only) and determinations of seed area and length/width ratios will also be carried out.

Multiple regression analysis will be utilized in an attempt to determine which factor or combination of seed quality factors contribute to the variation in yield potential.

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