

Results from the 1992 Alaska Barley Breeding Program

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INTRODUCTION

The development of improved plant cultivars is accomplished through comprehensive plant breeding programs. Such programs:

- 1) evaluate promising germplasm to identify superior-performing genotypes for use as parents;
- 2) create new genetic recombinations from these selected parental genotypes using crossing or other means;
- 3) evaluate segregating progeny from the resulting families while exerting selection pressure for desirable characteristics; and
- 4) identify superior-performing cultivars in yield trials conducted across multiple environments.

This circular documents the current status of research in cultivar development associated with the Alaska barley breeding program.

PROCEDURES

Parental Screening Trials

The purpose of parental screening trials is to identify the most elite germplasm developed outside of Alaska for use as parents in crosses. The primary screening criterion is early maturity, although other traits are considered. Germplasm is evaluated first as a single row or a single four-row plot, depending on the amount of seed available. Top-performing lines are evaluated in the Elite Variety Yield Trial the following year.

The Elite Variety Yield Trial is an ongoing, comprehensive evaluation, and comprises the second level of parental screening. It consists of four replications each of cultivars which show good performance under Alaskan conditions. In this trial, cultivars are evaluated over a period of several years to obtain a better indication of their average performance and, therefore, their potential for use as parents in crosses. Superior-performing cultivars are evaluated again in subsequent years of the test, while poorer-performing ones are dropped. Within each year, the performance of cultivars is measured as a percentage of the check variety 'Otal'. Percentages greater than 100 are used to indicate better performance (earlier heading, earlier maturity, shorter plant height, or higher yield), compared to Otal. The performance of cultivars evaluated for more than one year is determined by averaging the yearly comparisons with Otal. Thus, although cultivars may differ in number of tests or were tested in different years, all percentages reported are based on paired comparisons with Otal.

In addition to the Elite Variety Yield Trials, the 1992 Northwestern Canada Barley Trial was grown at Palmer. This trial consists of 25 cultivars, and is grown throughout Alberta and in Alaska to evaluate the performance of genotypes over a wide range of environmental conditions.

Segregating Families and Lines in Breeding Program

A diagram of the methodology used in the breeding program is given in Figure 1. After the initial cross is made between two parental genotypes ($P_1 \times P_2$), F_1 plants are grown and harvested in bulk. Progeny are advanced without selection to the F_4 generation, which is grown as a selection block. The earliest-maturing heads in this block are harvested. These selected heads are grown as headrows in the F_5 generation, where visual selection is practiced for early heading, early maturity, and optimum plant height. All breeding and selection is conducted at Palmer.

The selected families are then evaluated sequentially for the next three years in one-, two-, and three-replication trials, with superior-performing families advanced to the next level of testing. Superior families are again grown in a selection block in the F_9 generation, and the earliest-maturing heads are harvested. Selected heads are increased and evaluated for the next several years in yield trials to determine potential candidates for varietal release.

Advanced Yield Trials

The purpose of the advanced yield trial is to evaluate commercially grown cultivars developed in Alaska. This trial was grown at Palmer and Fairbanks in 1992, and consists of three cultivars with four replications each.

RESULTS

Parental Screening Trials

Approximately 70 entries were grown in unreplicated observation plots in 1992, and the performance of the five entries harvested, along with the check variety Otal, is given in Table 1. 'Arupo S' was extremely early heading compared to Otal, but it was not early maturing. This appeared to be due to a flush of late tillers which delayed maturity. Growing conditions were dry until mid-July, however late summer precipitation resulted in heavy tillering in this variety. This was accentuated by the fact that 'Arupo S' is a two-row variety, which tends to produce more tillers than six-row varieties. However, this variety is being used in crosses, and may have potential as a donor for early maturity due to its extremely early heading. 'Zaoshu 3' and 'Zhenong 12' also showed some promise as donors of early maturity in crosses, however they are both two-row types and possess undesirable characteristics.

The cumulative performance of entries in the Elite Variety Yield Trial is given in Table 2. Entries with two tests were evaluated in both 1991 and 1992, while entries with one test were evaluated for the first time in 1992. Several entries were earlier maturing than Otal (percentage >100), and most entries were shorter in plant height. Significant lodging has not occurred in this trial, so no information on lodging resistance is available. 'Nordyls', an older Norwegian variety,

showed particular promise, being 4.5% earlier than Otal and only slightly lower yielding than Otal.

Results from the 1992 Northwestern Canada Barley Trial are given in Table 3. 'VJ3-018' was the earliest-maturing entry in this trial, maturing two days earlier than Otal. BT670 is a selection from Otal, and was jointly released by Agriculture Canada and the UAF Agricultural and Forestry Experiment Station under the name 'Albright'. Consistent with previous Northwestern Canada Barley Trials in Alaska and Alberta, BT670 appears to have yield advantage over Otal, although it has generally been slightly later maturing.

Segregating Families and Lines in Breeding Program

The performance of F_2 , F_3 , and F_4 families is given in Table 4. One F_2 family, Arupo S/Olli, was grown in 1992. This family represents a cross between two very early maturing parents, and is segregating for two-row and six-row types. This family has potential as a source population for very early lines, although the pedigree suggests that the resultant lines might be deficient for other important agronomic traits.

Three F_3 families evaluated were developed by cross-

ing selections from Composite Cross XXXII with 2228, an unnamed line with the pedigree 'Olli/4/California Mariout/3/Betzes*6/Titan/(dwarf)Belonne', received from the Agriculture Canada Station at Beaverlodge, Alberta. Considerable variability exists in these populations, however their bulk performance was better than Otal for days to heading and days to maturity. These families possess short plant height; in fact, they may be shorter than desirable. Head size is relatively large for their plant stature.

The same families, one generation advanced, constituted the F_4 of the breeding program. Their bulk performance relative to Otal is similar to that of their counterpart F_3 families.

Seventy-nine F_6 lines, progeny of selected headrows from 1991, were grown in 1992. On the basis of heading, plant height, and maturity, as well as overall appearance, eighteen of these families were harvested. The average performance of these lines relative to Otal is given in Table 5. All lines harvested were significantly earlier maturing than Otal, and they were also shorter. Although short plant height generally results in reduced lodging, the height of these lines is shorter than desirable for mechanical harvest.

This is especially true if swathing is used, as the straw left after cutting should be tall enough to keep swathed grain well above ground level. Selection within these lines in subsequent generations will emphasize taller plant height.

Advanced Yield Trial

Results of the Advanced Yield Trial averaged across Palmer and Fairbanks locations is given in Table 6. The cultivars were similar in performance, with 'Datal' showing slightly higher grain yield. Table 7 gives the cumulative performance of varieties in the Advanced Yield Trial expressed relative to Otal. In four tests, Datal demonstrated higher grain yield than Otal, with equal maturity. Averaged over these four tests, all varieties were shorter than Otal and had better lodging resistance.

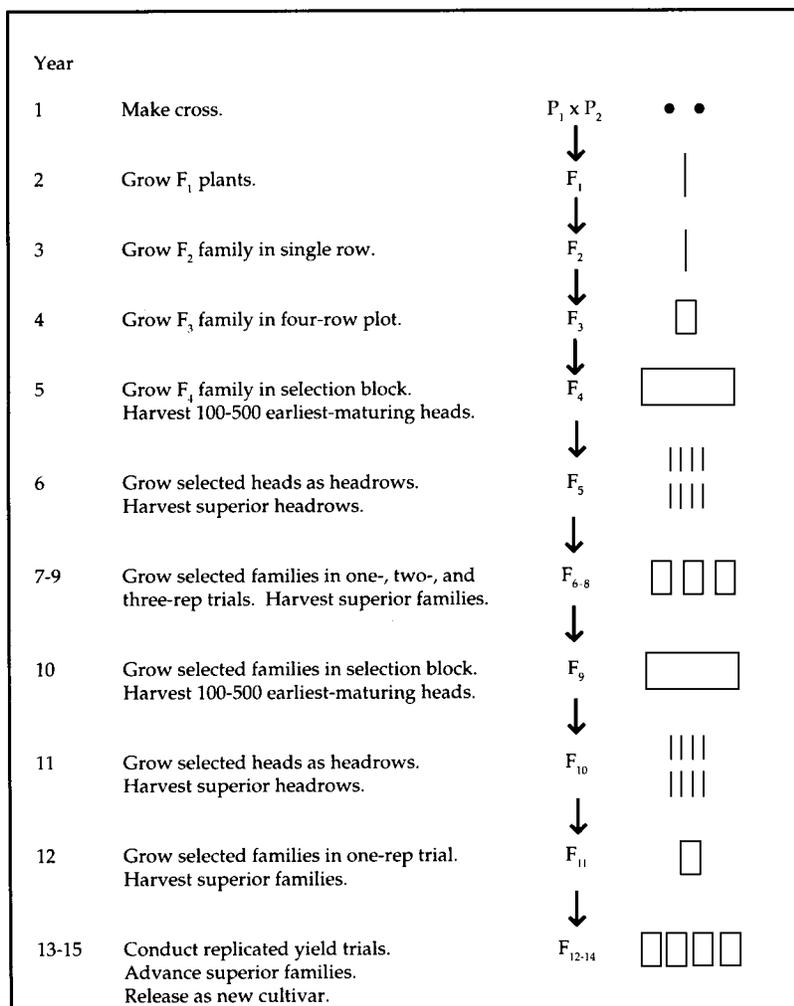


Figure 1. Breeding method used in the Alaska barley breeding program.

Table 1. Performance of selected entries grown as single four-row plots in 1992.

Entry	Days to heading*	Plant height (in)	Days to maturity*
Otal (check)	(6/29)	(80)	(8/14)
Arupo S	+9	40	-7
Zaoshu 3	+6	58	+7
Zhenong 12	+6	67	+7
Super Precoz 2H	-2	56	-10
Jo 1558	-1	56	+6

*No. of days earlier (+) or later (-) than Otal.

Table 2. Cumulative performance of varieties in the Elite Variety Yield Trial between 1991-1992.*

Variety	No. of tests	Heading	Maturity	Plant height	Lodging	Grain yield
CIMMYT E Bar #9	1	109.7	107.7	150.0	.	42.9
JO 1632	2	99.2	104.5	127.9	.	94.9
Nordyls	2	101.1	104.5	111.1	.	98.6
Bode	2	95.8	102.1	111.9	.	97.4
Olli	2	105.4	101.9	105.4	.	90.6
JO 1474	2	99.7	100.4	122.7	.	88.0
Nord	2	97.0	100.3	120.1	.	95.4
Arra	2	97.0	99.7	110.0	.	105.2
Arve	2	100.4	98.8	124.0	.	93.4
Potra	2	99.6	98.2	113.2	.	92.9
JO 1465	2	99.2	96.2	106.6	.	82.7
Ripa	2	95.6	95.6	119.2	.	90.5
Karin	2	95.8	93.8	121.1	.	84.1
Eero 80	2	99.9	92.8	138.9	.	110.4
Agneta	2	94.2	92.7	116.0	.	101.0
Super Precoz 2H	1	96.8	92.5	134.2	.	86.2

*Values greater than 100 indicate better performance (earlier heading, earlier maturity, shorter plant height, or higher yield) than Otal.

Table 3. Results of the 1992 Northwestern Canada Barley Trial grown at Palmer.

Variety	Days to maturity	Plant height (in)	Grain yield (bu/A)
VJ3-018	104	27.6	80.8
Otal	106	31.6	105.2
BT670	106	31.8	109.6
BT673	106	27.5	110.0
SD506	106	27.1	96.9
SD507	106	25.7	97.2
VJ3-007	106	27.5	81.5
Jackson	107	26.8	87.4
AC Stacey	107	29.5	114.7
BT671	107	30.0	98.1
V53-035	107	32.9	92.8
V3L-030	108	34.4	103.3
STEIN	109	28.5	90.5
VO5-014	109	28.3	104.9
V54-028	109	29.1	87.8
VO5-101	109	29.1	107.9
AC Lacombe 634	110	33.3	84.0
BT674	110	29.5	102.2
VN5-003	110	27.0	92.4
VTN-053	110	29.7	97.2
V3H-027	110	28.1	92.6
BT672	111	31.0	95.0
V5L-171	111	31.6	87.3
V38-082	111	25.8	89.5
VEN-295	114	24.8	73.8
LSD 0.05	2.5	1.9	12.0

Table 4. Performance of F_2 , F_3 , and F_4 families in 1992.

Generation	Family	Heading*	Plant height (in)	Maturity*
	Otal (check)	(7/2)	81	(8/17)
F_2	Arupo S/Olli	+11	60	+5
F_3	86CCXXXII-31-21/2228	+6	58	+4
"	86CCXXXII-159-81/2228	+6	58	+4
"	86CCXXXII-176-98/2228	+6	48	+4
F_4	86CCXXXII-31-21/2228	+6	50	+3
"	86CCXXXII-156-81/2228	+5	62	+3
"	86CCXXXII-176-98/2228	+8	49	+4

*No. of days earlier (+) or later (-) than Otal.

Table 5. Average performance of superior F₆ lines in 1992.

Generation	Line and No. represented	Heading*	Plant height (in)	Maturity*
F ₆	Otal (check)	(6/30)	77	(8/17)
	77II-67-21-120/8176-382-761-85-1 (2)	+7	59	+9
	86CCXXXII-31-21/2228 (10)	+9	49	+9
	86CCXXXII-159-81/2228 (4)	+5	52	+7
	86CCXXXII-176-98/2228 (2)	+8	53	+10
*No. of days earlier (+) or later (-) than Otal.				

Table 6. Average performance of entries in the Advanced Yield Trial grown at Palmer and Fairbanks in 1992.

Variety	Days to heading	Days to maturity	Plant height (in)	Lodging (1-9)*	Grain yield (bu/A)
Datal	52	88	32.1	7.3	83.8
Lidal	52	89	33.7	7.3	70.0
Otal	51	88	34.4	7.3	80.3
LSD 0.05	0.4	0.6	1.7	—	4.6
*1= completely upright, 9=completely lodged.					

Table 7. Cumulative performance of varieties in the Advance Yield Trial at Palmer and Fairbanks between 1991-92.

Variety	No. of tests	Heading	Maturity	Height yield	Lodging	Grain yield
Datal	4	100.2	101.2	110.3	130	105.1
Lidal	4	98.8	99.9	102.7	110	92.3
77II-69-63-3-1	2	96.8	94.4	108.3	160	73.5
*Values greater than 100 indicate better performance (earlier heading, earlier maturity, shorter plant height, or higher yield) than Otal.						