TABLE VII.—**Average Sexed Poult Weight at Twelve Weeks of Age.**

	Ration I					Ration II			
	Males		Females			Males		Females	
	No.	Av. Wt.	No.	Av. Wt.		No.	Av. Wt.	No.	Av. Wt.
House I Pen 1					House I Pen 2				
B.B.B.[1]	7	9.89	7	7.64	B.B.B.	7	10.19	10	7.76
B.W.[2]	9	9.09	6	7.38	B.W.	10	8.93	3	7.43
Houst II Pen 2					House II Pen 1				
B.B.B.	9	10.01	6	7.81	B.B.B.	12	9.87	4	7.59[3]
B.W.	10	9.12	5	6.93	B.W.	9	8.75	4	7.31
Variety sex and weight									
B.B.B.	16	9.95	13	7.73	B.B.B.	19	10.03	14	7.67
B.W.	19	9.10	11	7.15	B.W.	19	8.84	7	7.37
Sex per treatment	35		24			38		21	

[1]B.B.B.—Broad Breast Bronze.
[2]B.W.—Broad Whites.
[3]One poult not counted in average due to abnormal small size.

Malting Qualities

of North Dakota Barley Varieties

By O. J. Banasik

IN the July-August 1957 issue of the Bimonthly Bulletin the factors involved in the evalution of barley quality were discussed. The procedures are tedious and time consuming but yield an approximate concept of what may be expected when a variety is processed in the brewery.

The present report is a summary and interpretation of experimental malting tests on the 1954, 1955 and 1956 barley crops. The samples were grown at six North Dakota locations on 1/60 acre plots. The varieties were Kindred, Traill, Montcalm, Vantage, Tregal and Husky.

Malting procedures (2) developed by this laboratory were employed in the malting of the grain while standard analytical methods (3) were used for the final analysis. Included also in this report are some preliminary results from malting and brewing tests published by the Malt Research Institute (4). Although not conclusive, these indicate what can be expected from the five barley varieties Traill, Fox, U.M. 570, Husky and Parkland.

As Kindred barley is generally regarded as the standard in malting quality we will compare the quality characteristics of the different varieties with Kindred.

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TABLE I.—**Malting Quality of Six Barley Varieties Grown at Six Locations for Three Years.**

Variety	Yield	Kernel Assortment: Test weight	Plump	Thin	Total hull	Malt nitrogen content	Malt recovery	Wort nitrogen	Wort/ total nitrogen	Extract	Diastatic power	Alpha amylase activity
	bu/a	lbs/bu	%	%	%	%	%	%	%	%	L	20°units
Malting types												
Kindred	40.7	45.8	17.6	18.5	14.3	2.48	87.7	0.970	39.3	74.4	188	56.2
Montcalm	41.2	45.3	25.7	14.3	14.3	2.41	87.8	0.962	40.2	74.5	173	55.5
Traill	48.6	46.7	11.2	23.6	14.2	2.41	88.2	0.937	38.9	74.7	171	53.7
Average	43.5	45.9	18.2	18.8	14.3	2.43	87.9	0.956	39.5	74.5	177	55.1
Feed Types												
Vantage	48.3	46.0	34.5	10.3	14.6	2.52	89.7	0.780	31.2	72.5	125	30.4
Tregal	46.9	45.5	24.2	17.7	14.5	2.54	88.6	0.858	33.8	73.1	137	37.1
Husky	48.5	45.0	21.0	18.0	14.6	2.43	88.7	0.850	35.4	73.9	144	55.6
Average	47.9	45.5	26.6	15.3	14.6	2.50	89.0	0.829	33.5	73.2	135	41.0

TABLE II.—**Effect of Growth on Malting Quality.**

Variety	Yield	Kernel Assortment: Test weight	Plump	Thin	Total hull	Malt nitrogen content	Malt recovery	Wort nitrogen	Wort/ total nitrogen	Extract	Diastatic power	Alpha amylase activity
	bu/a	lbs/bu	%	%	%	%	%	%	%	%	L	20°units
Fargo	59.5	45.9	26.3	13.7	14.3	2.18	88.6	0.884	40.6	76.0	138	52.7
Langdon	53.4	45.2	25.9	14.6	15.3	2.42	88.9	0.872	36.5	73.4	157	50.6
Minot	58.0	46.9	24.7	13.7	13.9	2.29	88.3	0.832	36.4	75.0	146	45.0
Average	57.0	46.0	25.6	14.0	14.5	2.30	88.6	0.863	37.8	74.8	147	49.4
Edgeley	42.6	44.8	19.4	21.0	15.0	2.53	87.8	0.946	37.5	73.5	163	50.6
Dickinson	28.9	46.0	25.0	20.0	13.8	2.78	88.2	0.835	33.7	73.2	174	46.9
Williston	31.9	45.6	12.7	19.1	14.5	2.59	88.8	0.888	34.1	72.1	159	42.1
Average	34.5	45.5	19.0	20.0	14.4	2.63	88.3	0.890	35.1	72.9	165	46.5

TABLE III.—**Effect of Years on Malting Quality.**

Variety	Yield	Kernel Assortment: Test weight	Plump	Thin	Total hull	Malt nitrogen content	Malt recovery	Wort nitrogen	Wort/ total nitrogen	Extract	Diastatic power	Alpha amylase activity
	bu/a	lbs/bu	%	%	%	%	%	%	%	%	L	20°units
1954	47.4	45.0	16.4	23.5	14.7	2.59	88.8	0.989	38.5	73.5	166	52.9
1955	38.2	45.7	21.5	16.6	15.6	2.36	88.5	0.812	37.3	74.4	143	45.0
1956	51.6	46.5	29.1	11.1	13.0	2.44	88.1	0.877	33.5	73.7	159	46.3

Quality Factors

Test weight, kernel size and hull content are barley properties easily understood. Together with yield per acre they are primary factors in determining financial returns to the farmer. Too large a hull content is not desirable, especially for barleys to be used as feed. However, chemical characteristics are of greater importance because they are involved in the processing and industrial utilization of the malts produced from the barley. If the barleys grown do not meet the necessary requirements they will not be purchased by the industrial consumer. Thus, we must develop and grow barleys acceptable to the maltster and brewer.

Nitrogen content in barley is almost as important a factor as in wheat. Enough nitrogen must be present to supply the yeast nutrients in the brewing process. Too high a nitrogen content in barley is likely to cause instability in the finished brew. Kindred, as a standard acceptable barley, contains about the maximum permissible amount.

Malt recovery measures the amount of germination during malting and is of economic importance to the maltster. A high recovery is desirable provided satisfactory growth is attained.

Wort nitrogen content is the total soluble nitrogen contained in malt extract. Enough must be present in the finished brew for satisfactory results. The ratio of wort/total nitrogen is also very important as it indicates the percent of total malt nitrogen converted to the soluble form. Soluble nitrogen supplies the yeast nutrient during fermentation and also acts as the carbonic gas carrier in the finished brew. Too high a ratio can cause a hazy beer while a low amount can slow the fermentation rate.

Extract percent expresses the relative amounts of available fermentable carbohydrates. High extract is desirable.

Diastatic power and alpha amylase activity each expresses the ability of malt to convert starch into a soluble and more useful form. These must be in the correct ratio to control the conversion of starch in plant operation.

Results

Table 1 is a summary of the malting quality of six of the more important varieties grown at six locations over the three year period covered in this study. Generally, the feed barleys were higher in yield and in plump kernel and nitrogen content. However, they were lower in wort/total nitrogen ratio, extract, diastatic power and alpha amylase activity. These are reasons they are termed feed barleys—they fail to attain the desirable qualities of Kindred.

Traill barley, developed from

the cross Titan x Kindred by the North Dakota Agricultural Experiment Station and released in 1956, compares favorably with Kindred, except for its higher percentage of smaller kernels. On the basis of all pilot plant results in the Malt Research Institute (MRI) report on the 1954 and 1955 crop samples of Traill, it appears comparable with Kindred in quality, except as noted. Final rating of Traill as an acceptable malting barley depends on results obtained in commercial scale malting and brewing. The decision should be reached after this year's crop has been evaluated.

Husky, a new variety of Canadian origin, was grown on about one percent of the acreage in North Dakota in 1956. The MRI report states that this variety is relatively susceptible to leaf and head diseases and is late maturing. Pilot plant tests have indicated it is not suitable for malting and brewing. From 10 brews made on the 1955 crop, five were classed as unsatisfactory in clarity and four in flavor. Comparable brews made on Kindred indicated two samples were deficient in clarity and flavor. Table I shows Husky is low in wort/total nitrogen and extract. The MRI report indicated similar findings.

Tregal and Vantage definitely are not suitable for malting and brewing.

U.M. 570, Fox and Parkland have been tested by this laboratory but not to the same extent as the varieties listed in Table I. The following comments are reproduced from the MRI report. They agree generally with the results of this station.

U.M. 570 yields malts with higher diastatic power and alpha amylase activity than is usually considered acceptable for brewer's malts. However, these characteristics did not result in abnormal pilot processing for a majority of the collaborators. Further pilot and commercial scale testing of U.M. 570 is recommended before final conclusions are reached on its malting and brewing quality.

Fox was released in 1956 by the Wisconsin Agricultural Experiment Station. It has a stronger straw than Kindred and is smooth awned, resistant to stem rust, moderately resistant to smut and spot blotch, but susceptible to mildew. The kernels of Fox have light blue aleurone layers. Only a few samples were examined so further testing is necessary to provide more reliable data. The two tests that this laboratory has made on Fox showed it had a plumper kernel than Kindred and was equal to Kindred in yield, test weight, nitrogen content and extract. It is, however, lower than Kindred in amylase activity and wort/total nitrogen.

Parkland was bred at the Dominion Experimental Farm, Brandon, Manitoba, Canada, from the cross Olli x Montcalm x Brandon 1136. It was released in Canada as a named variety in 1956. The pilot malting and brewing results on a single sample of Canadian grown Parkland were generally favorable. Further pilot scale testing is recommended in the MRI report. Parkland was grown at all North Dakota experiment stations last year and showed promise in yield and quality characteristics.

Effect of Location and Year of Growth

Table II summarizes the malting data from the six locations. Each value represents the average of the six varieties included in table I for the three year period, and indicates that the first three stations listed, representing the Red River Valley and northern regions of the state, usually comprise the best barley producing area. Yield, plump kernel percentage, and extract are all generally higher. Also the nitrogen content is at a lower, more desirable level. The higher diastatic power in the Williston, Dickinson and Edgeley areas is attributed to the high nitrogen content and thinner kernels.

Table III provides information on the yearly variation in the barley grown at the various stations in North Dakota. The years 1955 and 1956 tended to produce barleys which were lower in nitrogen and thin kernel content, resulting in better quality.

Conclusions

Only Kindred and Montcalm barleys have been accepted by industry for malting and brewing. Husky, Tregal, and Vantage are definitely not suitable for malting and brewing, while the decisions on U.M. 570, Traill, Parkland and Fox are still pending.

Acknowledgment

Parts of the Malt Research Institute report, number XIII, in the discussion of the barley varieties are included in this paper. The Department of Agronomy supplied the barley samples and yield data.

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