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Stephen E. Tilmann, Delbert L. Mokma, Crop and Soil Sciences

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The Effect of N, P and K on Yield and Protein Content of Larker and Coho Barley Varieties

by D. R. Christenson and R. F. Dudley[1]

INTRODUCTION

Barley (*Hordeum vulgare*, L.) yields well in Michigan's Upper and northern Lower Peninsulas making it a valuable feed crop. In 1973, 6,650 acres of spring barley were grown in these regions of Michigan.

The varieties Larker, released in 1961, and Coho, released in 1969, comprise a significant portion of Michigan barley. Little or no research had been done on the effect of nitrogen, phosphorus or potassium on yield and protein content of these varieties. Consequently, a series of trials was initiated to study both the fertilizer requirements of these two varieties and the effect of applied fertilizer on protein content.

METHODS

Nitrogen Experiments

Ammonium nitrate was broadcast at rates of 0, 25, 50, 75 and 100 lb nitrogen (N)/acre prior to planting. Treatments were arranged on both varieties in a randomized complete block design with four replications. Planting and harvest dates, soil type and planting time fertilizer are given in Table 1.

Table 1. Planting dates, harvest dates, soil type and planting time fertilizer for nitrogen experiments

Year	Planting date	Harvest date	Soil type	Row fertilizer
1969	Apr 30	Aug 11	Rodman gravelly loam	300 lb 0-20-20
1970	May 7	Aug 4	Onaway loam	300 lb 0-20-20
1971	May 3	Aug 6	Trenary sandy loam	250 lb 0-20-20

The plot size was 6 ft x 25 ft. Three 16.5 ft rows were taken for yields. The grain was threshed and cleaned, and yields and weight per bushel were determined. A 30-g subsample was ground to pass a 40-mesh sieve and Kjeldahl nitrogen was determined (1).

Phosphorus and Potassium

This experiment was conducted at the U.P. Experiment Station on a Chatham stony loam soil. The treatments were applied each year in a band at planting time on the same site. Nitrogen as ammonium nitrate was drilled in prior to planting at a rate of 75 lb N/acre each year. Larker and Coho barley varieties were grown in a split-plot randomized complete block design with four replications. Rate of ferti-

[1]Associate Professor, Crop and Soil Sciences Department; and Agricultural Engineer, ARS, Beltsville, Maryland.

lizer comprised the main plot and varieties comprised the sub-plot.

The same plot size, harvest technique and laboratory methods were used as described above. Planting dates were May 8, 1971, May 28, 1972, and May 24, 1973. Harvest dates were August 19, 1971, August 17, 1972, and August 16, 1973. The soil tests were pH 6.7, 73 lb phosphorus (P)/acre, and 97 lb potassium (K)/acre.

RESULTS

Neither barley variety responded to applied nitrogen in 1970 but both did in 1969 and 1971 (Table 2). Manure had been applied prior to planting in 1970.

Table 2. Effect of rate of applied nitrogen on yield of Coho and Larker barley varieties

Variety	Nitrogen rate	YEAR 1969	1970	1971	Average(a)
	lb N/acre		bu/acre		
Coho	0	39.5	54.4	44.2	41.8
	25	52.6	59.9	53.1	52.8
	50	67.4	58.8	63.0	65.2
	75	68.2	59.1	60.8	64.5
	100	74.6	61.2	64.5	69.6
Larker	0	45.3	57.6	50.5	47.9
	25	60.1	55.0	74.6	67.4
	50	70.0	56.2	76.9	73.4
	75	82.2	59.4	62.4	67.3
	100	78.4	58.2	53.2	65.8
LSD (5%)		8.8	NS	17.4	7.6

(a) Average of 1969 and 1971.

Since there was not a significant year by treatment interaction for 1969 and 1971 the yield results from these 2 yr were averaged.

Yield of both barley varieties was increased over the check by all nitrogen rates. However, incremental increases were observed at applications of 50 lb N/acre over 25 lb N/acre for Coho and only for 25 lb N/acre over the check for Larker. Increases above these rates were not significant. Larker averaged 62.5 bu/acre as compared to Coho at 57.9 bu/acre.

Protein content of Larker barley was not affected by applied nitrogen (Table 3). On Coho barley it was not increased over the check by applications of up to 75 lb N/acre but was at 100 lb N/acre. Test weights were unaffected by increasing rates of nitrogen, but Coho had a higher test weight than Larker.

Phosphorus and Potassium

Yields were increased to a maximum with 75 lb K_2O/acre for both varieties (Table 4). The increase for Coho was less than required for significance but was very close. Other fertilizer combinations gave equally good, but not greater yields. Protein content and test weights were not affected by fertilizer treatment.

Table 3. Effect of applied nitrogen on protein content and test weight of Coho and Larker barley varieties

Rate of nitrogen	Protein content Coho	Larker	Test weight Coho	Larker
lb N/acre	%		%	
0	12.9	12.4	49.6	44.5
25	13.0	12.2	49.5	44.9
50	13.7	12.6	49.6	45.4
75	13.3	12.8	49.2	45.5
100	14.5	13.2	49.7	45.5
LSD (5%)	0.9		1.0	

Table 4. Effect of applied phosphorus and potassium on yield, protein content and test weight of Coho and Larker barley varieties

Fertilizer P_2O_5	K_2O	Yield Coho	Larker	Protein content Coho	Larker	Test weight Coho	Larker
lb/acre		bu/acre		%		lb/bu	
0	0	55.2	55.8	15.0	14.9	50.2	47.0
0	75	60.1	66.3	14.2	13.9	51.0	47.8
0	150	61.3	63.5	14.9	14.1	50.2	47.0
25	0	50.6	53.3	14.4	14.1	50.0	46.4
25	75	62.6	61.5	14.3	13.8	50.9	48.3
25	150	57.2	61.7	14.6	13.8	50.9	48.0
50	0	50.1	54.9	14.5	14.1	50.5	47.1
50	75	58.4	67.6	14.0	13.6	51.6	48.0
50	150	60.6	65.9	14.4	13.6	50.6	47.8
LSD		5.6		0.6		0.6	

Increasing rates of P_2O_5 (Table 5) did not affect yield, protein content or test weight of either variety. Yields were increased over the check by applications of 75 lb K_2O/acre but were not affected by applications above that. Protein and test weight were not affected by increasing rates of K_2O. Larker barley yielded more than Coho, but Coho had a higher protein content and test weight than Larker.

Table 5. Simple means for phosphorus, potassium and variety from the phosphorus and potassium study

Effect	Yield Coho	Larker	Protein content Coho	Larker	Test weight Coho	Larker
	bu/acre		%		bu/acre	
Phosphorus						
lb P_2O_5/Acre						
0	58.9	61.9	14.7	14.3	51.5	47.3
25	56.8	58.8	14.4	13.9	50.6	47.6
50	56.4	62.8	14.3	13.8	50.9	47.6
LSD (5%)	ns		ns		ns	
Potassium						
lb K_2O/Acre						
0	52.0	54.6	14.6	14.4	50.2	46.8
75	60.4	65.1	14.2	13.8	51.2	48.0
150	59.6	63.7	14.6	13.8	50.6	47.6
LSD (5%)	4.9		ns		ns	
Variety	57.2	60.7	14.5	14.0	50.6	47.5
LSD (5%)	2.0		0.3		0.3	

DISCUSSION

In the northern regions of Michigan small grains have usually not received enough fertilizer for optimum growth. These studies were conducted to provide current data on the nutrient requirements of two varieties presently grown.

Applied nitrogen increased yield and these data would suggest applying 50 lb N/acre on both varieties. While the increase above 25 lb N/acre on Larker is not significant, it is a strong trend and would be economical at $0.25/lb for nitrogen and barley at $1.40/bu. These data suggest that a farmer in a short nitrogen situation would obtain greater yields from Larker than from Coho.

Protein content of Coho barley tended to increase with increasing rates of nitrogen; Larker did not. Both varieties produced the same amount of crude protein per acre at 50 lb N.

The Chatham stony loam (P x K study) soil tested 73 lb P/acre and 97 lb K/acre. At these soil test levels the fertilizer requirement was 0 lb P_2O_5/acre and 75 lb K_2O/acre (2). Yields were at a maximum at this level of fertilization (Tables 4 and 5). Phosphate did not increase yields. Since protein content and test weights were not affected by fertilizer treatment, these data support applying phosphate according to fertilizer recommendations based on soil test levels.

Large applications of K_2O near the seed will reduce stands. With the drill used in this study, the fertilizer was separated from the seed. Even at applications of 150 lb K_2O/acre, there was little evidence of seedling damage caused by fertilizer being too close to the seed. Where drills do not separate the fertilizer from the seed, such damage may occur.

One of the concerns with the use of nitrogen on barley is the problem of lodging. In these trials, lodging was not severe enough to cause problems with combining when nitrogen was applied at 50 lb N/acre.

CONCLUSION

1. Larker barley yielded 3.5 more bushels per acre than Coho barley.
2. Coho barley had a higher test weight and protein content than Larker.
3. Larker and Coho barley varieties should be fertilized with up to 50 lb N/acre for maximum yields where manure has not been applied.
4. Maximum yields can be obtained when fields are fertilized with P and K at levels recommended based on soil test levels.
5. Protein content and test weight were not affected by applied nitrogen, phosphorus and potassium.

REFERENCES

1. Bremner, J. M. (1965). Total nitrogen. *In* Black, C. A. (ed.) Methods of Soil Analysis. II Chemical and Microbiological Properties. American Society Agronomy. Madison, Wis.
2. Fertilizer Recommendations for Michigan Vegetables and Field Crops (1970). Mich. State Univ. Ext. Serv. Bull. E-550.

Outlying Field Research Stations

These research units bring the results of research to the users. They are geographically located in Michigan to help solve local problems, and develop a closeness of science and education to the producers. These 15 units are located in important producing areas, and are listed in the order they were established with brief descriptions of their roles.

1. Michigan Agricultural Experiment Station. Headquarters, 101 Agriculture Hall. Established 1888. Research work in all phases of Michigan agriculture and related fields.

2. South Haven Experiment Station, South Haven. Established 1890. Breeding peaches, blueberries, apricots. Small fruit management.

3. Upper Peninsula Experiment Station, Chatham. Established 1907. Beef, dairy, soils and crops. In addition to the station proper, there is the Jim Wells Forest.

4. Graham Horticultural Experiment Station, Grand Rapids. Established 1919. Varieties, orchard soil management, spray methods.

5. Dunbar Forest Experiment Station, Sault Ste. Marie. Established 1925. Forest management.

6. Lake City Experiment Station, Lake City. Established 1928. Breeding, feeding and management of beef cattle and fish pond production studies.

7. W. K. Kellogg Farm and Bird Sanctuary, Hickory Corners, and W. K. Kellogg Forest, Augusta. Established 1928. Forest management, wildlife studies, mink and dairy nutrition.

8. Muck Experimental Farm, Laingsburg. Plots established 1941. Crop production practices on organic soils.

9. Fred Russ Forest, Cassopolis. Established 1942. Hardwood forest management.

10. Sodus Horticultural Experiment Station, Sodus. Es tablished 1954. Production of small fruit and vegetable crops. (land leased)

11. Montcalm Experimental Farm, Entrican. Established 1966. Research on crops for processing, with special emphasis on potatoes. (land leased)

12. Trevor Nichols Experimental Farm, Fennville. Established 1967. Studies related to fruit crop production with emphasis on pesticides research.

13. Saginaw Valley Beet and Bean Research Farm, Saginaw. Established in 1971, the farm is owned by the beet and bean industries and leased to MSU. Studies related to production of sugar beets and dry edible beans in rotation programs.

14. Kalamazoo Orchard, Kalamazoo. Established 1974. Research on integrated pest control of fruit crops.

15. New Horticultural Field Station, Clarksville. Established 1974. Research on all types of tree fruits, vegetable crops, and ornamental plants. First research plots to be established during 1975.

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