Factors affecting coleoptile lengths at leaf emergence, days to emergence, and relative growth rate in covered and hullness, two- and six-rowed barley (Hordeum vulgare L. and Hordeum distichum L.)
by Albert A Schneiter

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Agronomy
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Abstract:
Coleoptile length at leaf emergence, days to emergence, and coleoptile relative growth rate was studied in several varieties and crosses of two and six-rowed hulled and hulless barley. Special emphasis was placed on a hulless Stamm x Compana7 genotype which has a short coleoptile.

High temperature was found to adversely affect the three criteria of measurement studied.

Seed preconditioning by environmental conditions such as fertilizer levels, year grown, and dryland or irrigated conditions were found not to be a major factor effecting the three criteria. The presence of a, hull was shown to have a slightly detrimental effect on coleoptile length leaf emergence, days to emergence and coleoptile relative growth rate.

Coleoptile growth was shown to continue for only a short distance after leaf emergence in hulless Stamm x Compana7 composites.

IAA at 5 and 10 ppm was found to retard coleoptile length of the hulless Stamm x Compana7 but not that of Compana, the covered parent, or the derived Stamm x Compana7 genotype.

Greenhouse soil emergence tests showed that laboratory determined coleoptile length at leaf emergence was positively associated with coleoptile emergence, leaf emergence, and total seedling emergence from the soil.

In one field trial, yield was not related to laboratory determined coleoptile length at leaf emergence.

FACTORS AFFECTING COLEOPTILE LENGTHS AT LEAF EMERGENCE, DAYS TO EMERGENCE, AND RELATIVE GROWTH RATE IN COVERED AND HULLESS, TWO- AND SIX-ROWED BARLEY (HORDEUM VULGARE L. AND HORDEUM DISTICHUM L.)

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This thesis is dedicated to my mother and father.

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ABSTRACT

Coleoptile length at leaf emergence, days to emergence, and coleoptile relative growth rate was studied in several varieties and crosses of two and six-rowed hulled and hulless barley. Special emphasis was placed on a hulless Stamm x Compana^7 genotype which has a short coleoptile.

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INTRODUCTION

Hulless or naked barley has attributes which would make it more desirable than common hulled types for some purposes. Hulless barley may have great potential in spring barley growing areas of this country.

It would appear to the author that the absence of the hull would result in barley having increased export value. Many countries of the world, especially in the far east, utilize pearled or otherwise de-hulled barley for food. The weight loss by pearling would be reduced. For some products where pearled barley is desired or essential, such as for dog food, hulless barley could be used without pearling. It would appear that the absence of a hull would enable barley to be used with greater efficiency in almost any situation where barley is fed. Since the hull has little by-product value, a hulless barley would be preferred in barley processing plants in the manufacture of starch and carbohydrate utilizations of barley.

Many carloads of corn are shipped into Montana each year for use in rations where high fiber content is undesirable. With a surplus of barley produced in this state, it would seem to be desirable to replace this corn with low fiber hulless barley at a saving in cost for feed.

Because of its possible desirable attributes, a research program was initiated at Montana State College in 1953 to develop varieties of hulless barley which would be comparable in agronomic performance to hulled varieties presently being grown and produced.

Hulless varieties were crossed with several common hulled varieties and many genotypes evolved. One of the promising genotypes developed was a backcross-derived hulless Compana. The most important criterion used in selecting promising lines was high percent threshability.

Woodward (26) and others have reported poor germination or poor emergence in some types of hulless barley. Preliminary observations indicate this could be a problem in the hulless derived types being developed in Montana.

This study was initiated to determine the possible existence and causal factors affecting poor emergence.

The objectives of this project were (1) to determine coleoptile length and its growth rate in several barley genotypes as affected by temperature, environmental conditions, and the presence or absence of a hull; (2) to isolate factors determining coloeptile growth; and (3) to determine if coleoptile length has any effect on emergence.

LITERATURE REVIEW

Hulless or naked barley, according to Vavilov (23), had its origin in the mountainous regions of central and western China. Much of the world's hulless barley is still grown in Asia with Japan being one of the world's major producers.

Hulless barley has never been widely accepted or produced on a large scale in this country. There is good reason for this. Hulless barley varieties now available have several faults. Germination is apt to be low, disease susceptibility is high, and yields are relatively poor as compared to hulled varieties. Woodward (25) found that quite often the spike only half emerged from the leaf sheath. Ten to twenty percent of the kernels produced a "loose" coleoptile which failed to penetrate the soil crust.

Harlan (10) gives reasons for and against the production of hulless barley. He has stated that brewers do not want it because the hull is necessary to filter wort. More recently cellulose filters have been developed and this statement no longer applies. Those who feed cattle and horses don't want it because the hulls are of some advantage in feeding these classes of livestock. He states that hulless barley is good only for hog and chicken feed and in the manufacture of pearled barley.

Generally speaking, hulless barley would have several advantages as compared to hulled types. Hulled barley may be considered to be about 13 percent hull.

Advantages of hulless barley are (7):

1. 13 percent less weight to handle in harvesting, storing, shipping and processing operations.
2. Test weight is typically increased from 48 to 60 pounds per bushel resulting in a net storage requirement of about 2/3 of a comparable hulled crop and also a saving of 2/3 in transportation costs required to move a given crop when charges are based on bulk.
3. Reduction in barley grinding costs.
4. Increase in feed value equal to or greater than that of corn on a per pound basis.

The absence of the hull affects chemical composition of barley. A comparison of the chemical composition of a typical hulless barley with a hulled high and low grade feed barley is given by Morrison (14) and is recorded below.

Barley Type and Grade	Total Dry Matter, %	Digestible Protein, %	Total Digestible Nutrients, %	Nutritive Ratio	Protein %	Fat, %	Fiber, %	Nitrogen-Free Extract, %	Mineral Matter, %
Hulless Barley	90.2	9.2	80.4	7.7	11.6	2.0	2.4	72.1	2.1
Feed Barley, High grade	90.3	10.8	73.2	5.8	13.5	3.5	8.7	60.5	4.1
Feed Barley, Low grade	92.0	10.0	61.3	5.1	12.3	3.5	14.7	56.2	5.3

From the analysis reported in the above table hulless barley compares quite well to the covered types in almost all aspects. It is much higher in T.D.N. and N.F.E., lower in fat, much lower in fiber and equal to covered barley now being used in the other components. It should be noted that these differences of hulled and hulless barley are confounded with varietal differences.

Three year average analysis of barley varieties being used in Montana to develop hulless barley are given below (7).

Variety	Fat %	Fiber %	Protein %
Compana	2.00	5.00	10.2
Stamm*	2.45	2.20	10.0
Titan	2.20	5.00	10.8
Shortawn*	2.30	2.40	10.2

* Hulless varieties.

From these analyses we can see that in these particular hulless varieties fat is higher, fiber lower, and protein equal to the hulled types.

The chemical analysis of the hull and grain of the hulless barley variety Stamm is given in the following table.