# A CORRELATION STUDY OF VARIOUS AGRONOMIC AND QUALITY CHARACTERS IN BARLEY

by

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## Introduction

Increased yield and improved malting quality are two important objectives in a barley improvement program. Numerous factors, both environmental and hereditary, determine the expression of these characters, making the effective selection of individual plants or their progeny extremely difficult. The plant breeder is confined to selection of certain desirable characters which are visible. He can only hope that some of these selections will prove satisfactory as to yield and quality when the testing stage is reached. Therefore he is forced to select very large numbers of plants in order to increase his chances of obtaining high yield and good quality in combination with other desirable characters. Any knowledge which tends to increase the efficiency of visual selection toward this end will prove invaluable to the barley breeder.

Frankel (5) states that increases in productivity are accomplished in two ways: (1) by overcoming limiting factors, the effects of which can be observed and (2) by assembling productivity genes. The main increases in yield have been achieved by overcoming these limiting factors, that is, such factors as condition disease susceptibility, drought susceptibility, and susceptibility to shattering, rather than by assembling productivity genes. The principal difficulty in selecting for productivity genes arises from the fact that yield components are so subject to environmental variation that the recognition of favorable genotypes is difficult even in replicated yield trials. Genetic concepts require segregating populations greatly exceeding in number those which can be included in such a trial. Hence the efficiency of selection of single plants and their immediate progenies constitutes a major problem in selection for yield itself.

In order to increase the efficiency of selection of single plants

for yield and quality it is necessary to determine if these invisible characters are associated with any observable characters. With this in mind numerous workers have carried out correlation studies in the various cereal crops. However, relatively few of these studies have been concerned with barley. As far as the author has been able to determine, only two such studies have been published in Canada and these have dealt only with characters pertaining to quality. The present study was undertaken to determine the possible relationship between yield, nitrogen content, and certain plant and seed characters in barley. The main object is to determine whether any one character is closely enough associated with yield or with nitrogen content to be used as a guide in selecting single plants or the progeny of single plants.

## Review of Literature

Numerous studies involving the correlation of plant characters with yield have been carried out with many crops in the last thirty five years. Many of these studies have been made in the cereal crops, wheat, oats, and barley. Since this study is directly concerned with barley, the literature reviewed here will be that which is most closely allied to the subject; namely, studies in wheat and barley, with some mention of oats.

It is interesting to note that as early as 1821, Sir Humphrey Davy (4) remarked that it was unfortunate that so many high yielding grains "preferred to lie upon the ground". In 1919, almost one hundred years later, Garber and Olson (6) reported that they found no significant correlation between yield and lodging in a study involving 15 strains of barley. In a study of 146 varieties of wheat, Goulden and Elders (7) found a negative correlation between yield and straw strength. Kiesselbach et al.(12) found no correlation between yield and lodging in a study involving spring wheat, oats and barley. Leasure et al. (14) also reported no correlation between yield and breaking strength of straw in barley.

Goulden and Elders (7) found a negative correlation between yield and days to head in wheat. Bridgford and Hayes (3) working with 61 strains of varieties of wheat reported this relationship to be positive. Wexelsen (23) in his paper on quantitative inheritance and linkage in barley reported that date of heading was correlated with the factors for large teeth on the lemma nerves, the factor for two row, the factor L for long haired rachilla, and the factor R for rough awns.

Kohls (13) reported a positive correlation between yield and height of plant from a study involving 7 varieties of barley. Bridgford and

Hayes (3) reported the same relationship in wheat. Robertson and Koonce (20) studied 41 varieties of barley and reported a positive correlation between these two characters. Leasure et al.(14) also working with barley, reported a positive relationship as had the previous workers. However, Kiesselbach et al.(12) reported no correlation between yield and height of plant in barley, oats, or wheat. Boyce et al.(2) stated that selection for straw length did not increase the efficiency of selection for yield, in wheat.

Quisenberry (19) in a field study of winter and spring wheats, found a significant positive correlation between yield and number of kernels per head, and between number of kernels per head and 1000 kernel weight (K.W.). Thayer and Rather (22) reported that yield of barley was affected by rate of seeding; that the extent of tillering, length of head, and number of kernels per head decreased as the rate of seeding increased. They believed number of kernels per head to be associated with yield. Boyce et al.(2) stated that the only yield component consistently varying with total yield in their study of wheat, was the number of kernels per head.

Thayer and Rather (22) had suggested a positive correlation between yield and head length in barley and this was found to be so in the study conducted by Leasure et al.(14). They also reported a positive correlation between yield and test weight in barley as had Kohls (13) and Robertson and Koonce (20). The same highly significant positive relationship was reported to exist in wheat by Hayes et al.(8), Bridgford and Hayes (3), and by Kiesselbach et al.(12). Worzella (24) found kernel weight to be positively correlated with test weight in wheat.

Quisenberry (19) found significant positive correlation between yield and 1000 K.W. in wheat as did Bridgford and Hayes (3). Worzella (24)

found no correlation between 1000 K.W. and purple straw color in wheat, whereas Middleton and Herbert (16) reported that in each of three years purple strawed types produced kernels which were significantly heavier than those from white lines.

Anderson et al.(1) conducted a study involving seven varieties of barley and found a negative correlation between 1000 K.W. and nitrogen content and between 1000 K.W. and saccharifying activity. Lejeune (15) studying $F_3$ lines of a Chevron x O.A.C. 21 cross, also found a negative correlation between 1000 K.W. and nitrogen content. He reported a positive correlation between 1000 K.W. and stem rust reaction.

Thayer and Rather (22) believed yield to be closely associated with the extent of tillering in barley. They stated that as the rate of seeding increased, the extent of tillering decreased and that yield was also decreased. Hunter (10) reported that the high yield of the barley varieties Spratt-Archer and Spratt was associated with high tiller survival.

Goulden and Elders (7) found a negative correlation between yield and susceptibility to stem rust in wheat. They also found that a negative relationship was indicated for yield and susceptability to leaf rust. Bridgford and Hayes (3) also reported a negative correlation between yieldand susceptability to leaf rust in wheat.

Anderson et al.(1) reported that they found a definite association between nitrogen content and saccharifying activity. They studied seven varieties of barley and stated that this is an intravarietal relationship and does not apply between varieties. Environmental conditions which tend to produce high nitrogen barleys also tend to produce barleys high in saccharifying activity and produce malts of