Chapter I

Introduction
Barley (*Hordeum vulgare* L.) is one of the earliest crop to be domesticated. It is the world’s fourth most important cereal after wheat, maize and rice. The barley grains are primarily used for human consumption in various preparations, as a feed for livestock, and to a limited extent for the manufacture of beverages. Barley based agro industries market bear, pearl barley, lemon barley, water and lime barley. Barley has often been used as a model crop for many research programme because of its less chromosome number, large chromosome size, easy handling and genetic markers etc. However, its yield level is low and therefore, need to be improved. During 2007, the barley production was recorded at 1550 million tonnes (MT) from an area of 826 million hectare (MH) in India (FAO, 2008).

The major barley producing countries of world are CIS (USSR), Canada, USA, Germany, France, Spain, Turkey, U.K., Denmark and Australia. India does not figures in first 15 countries of the world in terms of area and production of barley in terms of productivity, the European countries having winter type barley had with more than 5.0 tonnes/ha. The barley grain available to the industries possesses higher husk and protein content and less carbohydrate which results in poor malting qualities. The continuous decline in barley area and production during 80’s and 90’s triggered a shortage for good quality grains of malting.

In India major barley growing states are U.P. Rajasthan, Madhya Pradesh. Uttar Pradesh alone accounts for 44 percent of area and 45 percent of production of barley in country followed by Rajasthan, Punjab and Haryana. The states like Bihar and Madhya Pradesh with considerable
area under barley yield far below the national average of 1.73 t/ha where most of barley is under rainfed cultivation. In India more than 7.1 million hectare land is of saline/sodic nature in indo-gengatic plains and sea shores like Sunderban delta in West Bengal and parts of Gujarat.

The process of replacing thousands of local varieties or land races with a few uniform and high yielding ones has accelerated the genetic erosion of the important food and cash crop around the world. Economic superior varieties as well as agro-technical requirements related to their introduction has stimulated structural changes in agriculture practices favouring large area monocultures. This strategy has greatly improved food production but has also generated some problems related to environment and agricultural production per unit area. It has become obvious that genetic uniformity, which arose with cultivation of only few varieties with similar genetic backgrounds, makes a particular crop vulnerable to epidemic of pests, disease and elevates stress. Barley is one of the most important crop in semi arid areas of north Africa and west Asia where approximately 11 million hectares are devoted to its production.

Yield is a complex character and is the final product generated by the inherited characters that the controlled by polygenes and are markedly influenced by environmental fluctuations. Although the percentage of homozygous genotypes increases considerably with each generation, however the number of plants that are necessarily involved in the selection becomes so large that the size of population grown becomes unmanageable.

The development of an effective plant breeding programme is dependent upon the existence of genetic variability. The magnitude of variability present in the gene pool of a crop species is of ut-most
importance to a plant breeder for starting a judicious plant breeding programme. The variability is measured through parameters like heritability, genetic divergence and expected genetic gain. Heritability and genetic advance are important to provide information about correspondence between genotypic and phenotypic variance. Heritability estimates along with genetic advance are normally more helpful in predicting the grain under selection than heritability estimates alone. However, it is not necessary that a trait showing high heritability will also exhibit high genetic advance (Johnson et al., 1995). The high heritability accompanied with high genetic advance indicates that most likely the heritability is due to additive gene effects and selection may be effected.

The character association among the attributes is estimated by genotypic and phenotypic correlation which is used to find out the degree and direction of relationship between two or more variables. Path coefficient analysis is simply a standardized partial regression coefficient which splits the correlation coefficient into the measures of direct and indirect effects (Dewey and Lu, 1959).

The basic difference between genotype and their yield stability is the wide occurrence of genotypic environmental interaction which can be attributed to reaction of genotype to known environment such as drought and stress factors and consequently resistance breeding is of significant in improving yield stability. The adaptation is the property of genotype permitting its survival under selection whereas adaptability is the genetic ability, which results in stabilization of genotype environment interaction by means of physiological (individual) and genetical (population) reaction of organism to environments. The adaptability is thus a manifestation of genotype environment interaction (Allard and Bradshow, 1964) which is in turn is a genetic character inherited by organism through the process the
evolution (Jinks and Mathur (1955). The genotype environmental interactions have an important bearing on the plant breeding problems. An obvious and significant effect of those interactions is to reduce the correlation between phenotype and genotype with the result that the valid inferences become more complicated. This implies whether the interest is to determine the mechanism of inheritance or to evaluate new strains. Comstock and Moll (1963) have shown statistically the effect of large genotypic environment interaction in reducing the progress from selection.

Oka (1967) has classified crop adaptability into two categories (1) the general which refers to the ability of crop plants to produce a consistence high yielding under varied environmental conditions. (2) Specific which indicates the ability to react and resist to a particular condition such as cold, drought, or pests. The stability and productivity are the two consistent characters hence, it is possible to breed varieties having high yield potential, stability and high productivity. There are two concepts of stability (Static and Dynamic). In static concept the stable genotype shows variation in the performance over environments regardless of any variation of the environmental conditions. The dynamic concept permits a predictable response to environments and a stable genotype correspondence completely to the estimated level or the prediction of performance. According to the dynamic concepts, only the deviation of a genotype from this general relation is considered as a contribution to unstability because the general response of all genotypes may be interpreted as environmental effects. Several models including regression approach model of Years and Cochran (1938), stability factor of Lewis (1954), static of Plasted and Peterson (1959) and covalence of Wricke (1962) have been proposed for the estimation of (G x E) interaction. The regression approach model was later utilized by Finlay and Wilkinson
(1963) to select stable genotype in barley. Eberhart and Russell (1966)
later improved upon the regression approach and added other parameters,
deviation from regression ($S^2_{di}$) beside regression coefficient ($b_i$) for
stability. They defined genotype with unit regression and least deviation
from regression as stable genotype. Perkins and Jinks (1968) used the
same two parameters for stability but at the same time modified the method
of estimation of regression coefficient. They opined that instead of
regression mean performance ($E_i + g_{ij}$) on the environmental index ($E_i$),
genotype unenvironment interaction ($G \times E_{gi}$) should be regressed on the
environmental index.

Keeping the above in view, the present investigation entitled
"A study on stability for yield and yield contributing characters in
barley (Hordeum vulgare L.) under Bundelkhand situation" is being
undertaken with the following objectives:

(i) To find out the variability, heritability and expected genetic advance
    for different characters under study.

(ii) To estimate the character association between yield and its
    component characters through correlation and path analysis.

(iii) To find out the phenotypic stability for various characters under
different environments.

(iv) To suggest a suitable breeding plan based on the present
    investigation.