CHAPTER-I
INTRODUCTION

Wheat (*Triticum spp.*) is accorded a premier place among the cereals because of the vast acreage devoted to its cultivation, its high nutritive value and its association with some of the earliest and most important civilization of the world. Wheat is the second most important staple food next to rice. It is known for its remarkable adaptation to a wide range of environments and its role in world economy. Three species of wheat *viz.*, *Triticum aestivum* (bread wheat), *Triticum durum* (macaroni wheat) and *Triticum dicoccum* (emmer wheat) are presently grown as commercial crop in India. Globally wheat has 221.55 million hectares area, 750.44 million metric tonnes production and 3.39 metric tonnes per hectare productivity and in India wheat has 30.22 million hectares area, 87.00 million metric tonnes production and 2.88 metric tonnes per hectare productivity during 2016-17 (Anon., 2018). In Gujarat wheat has 996 thousand hectares area, 2938 thousand tonnes production and 2950 kg/ha productivity during 2016-17 (Anon., 2017).

*Triticum aestivum* is most extensively grown crop among cereals in the world, engaging 17 per cent of crop acreage from world over, giving food to about 40 per cent of world population and supplying 20 per cent of the total food calories and protein in human diet (Bhutto *et al.*, 2016). Wheat occupies about 32 per cent of the total acreage under cereals in the world. The main wheat growing countries include China, India, U.S.A., Russia, France, Canada, Germany, Turkey, Australia and Ukran. In India, wheat is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Maharashtra, Karnataka and Gujarat. Globally, demand for wheat by the year 2020 is forecast at around 950 million tonnes per year. This target will be achieved only, if global wheat production is increased by 2.5 per cent per annum.

The wheat belongs to the genus *Triticum* of the family Poaceae and its origin is believed to be Middle East Region of Asia (Lupton, 1987). The bread wheat is hexaploid with chromosome number 2n=42 is cultivated in all the wheat growing areas of the country, the macaroni or durum wheat (tetraploid, 2n=28) is mostly
grown in the Northern (Punjab) and Southern states, while the emmer wheat (tetraploid, 2n=28) is confined to the Southern states (mainly Karnataka) and some parts of Gujarat.

Wheat is a unique gift of nature to the mankind as it can be molded into innumerable products like chapattis, breads, cakes, biscuits, pasta and many hot and ready-to-eat breakfast foods. The uniqueness of wheat in contrast to other cereals is that wheat contains gluten protein which enables leavened dough to rise by forming minute gas cells and this property enables bakers to produce light breads. For commercial production and human consumption, durum wheat is the second most important *Triticum* species, next to common wheat (*Triticum aestivum*). Tetraploid wheat has been under cultivation in Ethiopia since ancient times. Among the tetraploid, durum wheat (*Triticum turgidum* L. var. durum) is the predominant species. Durum wheat (*Triticum durum*) is a monocotyledonous plant of the *Poaceae* family. It is the only tetraploid (AABB, 2n=4x=28) species of wheat which has commercially a great importance and carries raw material of numerous foods such as macaroni and semolina in alimentation of world population and is a promising and viable alternative crop for farmers (Shewry, 2009). Durum wheat (*Triticum durum*) is an economically important crop and widely grown in most parts of the world. It is cultivated on 10 to 11 per cent of the world wheat areas and accounting about 8 per cent of the total wheat production (Ganeva et al., 2010). According to Central Statistics Authority (CSA, 2011), the average world productivity of durum wheat is 25 quintals per hectare.

Before the onset of well-organized improvement programme, some of the old but prominent varieties of durum wheat namely Haura, Bansi, Kathia, Jalalia, Jamalia, Gangajali, Khandwa and Malvi were mainly grown. However, the introduction of dwarf durum wheat with rust resistance revolutionized durum cultivation under irrigated conditions. This way the cultivation of durum wheat gained popularity in certain parts of Punjab, Haryana, Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh and Karnataka. The nutritional composition indicated that 100 g of durum wheat provides 339 calories and it consisted carbohydrate 71 g, protein 14 g, fat 2.5 g, minerals 2 g and considerable proportions of vitamins (thiamine and vitamin-B) and minerals like zinc and iron (Wolde et al., 2016). The development of high yielding varieties with desirable quality characteristics is the major objective in durum wheat breeding programme. For effective selection in
durum wheat, breeders should increase their efforts to know the genetic variability of important agronomic traits (Abinasa et al., 2011).

The basic rational in any crop improvement programme is to increase the yield potential of the crop. Grain yield is a complex and polygenic trait, and in order to study it properly, different factor affecting the grain yield must be considered and evaluated with regard to their contribution to grain yield. For a particular crop, information on nature and magnitude of variability present in the population due to genetic and non-genetic causes is an important pre-requisite for commencing any systematic breeding programme.

Availability of sufficient genetic variability is very important in a crop improvement programme. Analysis of variability among the traits and the association of a particular character with other traits contributing to yield of a crop would be of a great importance in planning a successful breeding programme (Mary and Gopalan, 2006). The choice of parents is of paramount importance in breeding programme. For effective selection, information on nature and magnitude of variation in population, association of characters with yield and among themselves and the extent of environmental influence on the expression of these characters are necessary (Yagdi, 2009). Therefore, it is essential for a breeder to measure the variability with the help of parameters like phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance. Hence, these above said parameters give the information regarding the availability of genetic variability for different characters in germplasm. Therefore, study of genetic variability of grain yield and its component characters among different varieties provides a strong basis for selection of desirable genotypes for augmentation of yield and other agronomic characters.

Different components of grain yield often exhibit varying degree of association with grain yield as well as among themselves. In order to accumulate optimum combination of grain yield contributing characters in a single genotype, it is essential to know the relationships among themselves. Character association studies provide better understanding of yield components which helps the plant breeders to improve yield through indirect selection for highly heritable traits which are associated with yield. Correlation and path analysis could be used as an important tool to bring information about appropriate cause and effects relationship between yield and some yield components (Khan et al., 2003).
Further, the grain yield is influenced by its various components directly and/or indirectly via other traits that create a complex situation for breeder before making desirable selection. Therefore, path coefficient analysis developed by Wright (1921) could provide a more realistic picture of the relationship, as it partitions the correlation coefficient into direct and indirect effects of the variables. Path coefficient analysis provides means to quantify the interrelationship of different yield components and indicate whether the influence is directly reflected in the yield or take some other path ways to produce an effect. Dewey and Lu (1959) employed this for the first time in plant to dissent angle the direct and indirect influences on the component of the grain yield. Thus, character association and path analysis provide the information of yield contributing characters and a breeder can practice selection using this information for the isolation of superior accessions from gene bank.

Keeping in view of all these aspects, the present study in durum wheat is undertaken with following objectives:

1. To find out genetic variability for grain yield and its contributing characters.
2. To find out the association between grain yield and yield contributing characters.
3. To determine the direct and indirect effect of different characters on grain yield per plant using path coefficient analysis.