CHAPTER-I

INTRODUCTION

Wheat (\textit{Triticum spp.}), the most widely cultivated food crop of the world is known for its remarkable adaptation to a wide range of environments and high nutritive value. It is also the largest single agri-trading commodity with a great impact on world economy. Wheat is the second most important cereal staple food crop consumed by nearly 35 per cent of world population and provides 20 per cent food calories (Anon., 2014). It is the most widely cultivated food crop of the world.

Wheat is grown over a range of latitudes and known for its remarkable adaptation to a wide diversity of environments. It 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 Ukrain. India is the second largest wheat growing country of the world after the China. Uttar Pradesh, Madhya Pradesh, Punjab, Haryana, Rajasthan, Maharashtra and Gujarat are the major wheat growing states of India. India accounts for an area, production and a productivity of 30.72 million ha, 97.44 million metric tonnes and 3117 kg per hectare, respectively. In Gujarat, it occupies 1.00 million hectares of land, 2.93 million metric tonnes of production and 2950 kg per hectare of productivity. (Anonymous, 2016-17).

Wheat belongs to the genus \textit{Triticum} of Poaceae family and believed to be originated from South West Asia (Lupton, 1987). In fact, there are three natural group of wheat from polyploid series of \textit{Triticum} species viz. \textit{Triticum aestivum} L., a hexaploid wheat (bread wheat) which is having chromosome number $2n = 42$, \textit{Triticum durum} Desf, a tetraploid wheat (macaroni wheat) with chromosome number $2n = 28$ and \textit{Triticum dicoccum} Schubl, also a tetraploid wheat (emmer wheat) with chromosome number $2n = 28$ are presently grown as commercial crop in India, covering about 86, 12 and 2 per cent area, respectively. The bread wheat is cultivated in all the wheat growing areas of the country, the macaroni or durum wheat is grown mostly in Northern (Punjab) and Southern states, while the emmer wheat is confined to the Southern states (mainly Karnataka) and some parts of Gujarat.
**Introduction**

The grains of most of the durums grown today are amber-colored and larger than those of other types of wheat. The factors that make durum an export commodity are, increasing global demand, value addition potential, minimum quarantine issues related to it, better price and immunity to a cosmetic disease known as Karnal Bunt. Durum wheat provides better nutrition, as it is rich in protein, β-carotene and essential micronutrients like iron and zinc. Various end products namely Ladoo, Chapati, Noodles, Paratha, Dhebra, Bhakhri, Pasta can be prepared from durum wheat flour.

Most durum wheat is grown in Mediterranean countries, the former Soviet Union, North America, and Argentina. U.S. durum production is primarily in North Dakota. However, the largest producer of durum is Canada where it is the third most prominent crop behind red spring wheat and canola, the primary region for durum is in the Southern quarter of Saskatchewan. World production of durum wheat ranges from 30-35 million tonnes. More than 80 per cent of the total product is consumed in the country of production, with only Canada, USA and Argentina being mainly exporters. Durum wheat accounts for only 4 per cent of the total world production. Nearly 10-12 million tonnes of durum, valued around US $ 2600 million is traded annually.

Wheat breeding has concentrated on increased yield, earliness, grain quality and disease resistance especially the leaf and stem rusts. India has made tremendous progress in wheat production and productivity by evolving high yielding varieties (Chopra, 2001). During the last 30 years, there has been a 1 per cent annual genetic gain in yield of new varieties. However, still there is a wide scope for increasing inherent productivity potential of presently grown varieties by way of using various breeding methods and statistical techniques for genetic analysis, which are being practiced in self-pollinated crops. This may help in achieving 2 per cent increase in annual genetic gain which is anticipated to fulfill the food requirements of the country.

It is now believed that the yield levels of the present semi dwarf wheat have reached a plateau due to inadequate exploitation of gene pool in relation to study the genetic architecture of important traits affecting yield. The major objective in most wheat breeding programme is to improve the genetic potential for grain yield, which is mainly determined by three components *viz.*, number of tillers per plant,
number of grains per spike and grain weight. The knowledge of nature and magnitude of fixable and non-fixable type of gene effects, governing the yield and its components is essential in order to formulate an efficient breeding programme to achieve the maximum genetic improvement in this crop.

The heterosis and combining ability studies are useful for the evaluation of newly developed lines for their parental usefulness and to know the gene actions involved in the inheritance of various characters. Heterosis breeding has proved to be potential method of increasing yield in most of the cross pollinated crops. The magnitude of heterosis is associated with heterozygosity because the dominance variance is associated with heterozygosity. The commercial exploitation of heterosis in self-pollinated crop like wheat has limited application owing to technical difficulties involved in hybrid seed production in sufficient quantity. However, the discovery of male sterility and genes which restore fertility (Wilson and Ross, 1962 and Schmidt et al., 1970) and the use of chemical hybridizing agents (CHAs), which act as gemetocides (Borghi et al., 1988 and Morgan et al., 1989) in wheat, have encouraged many workers to examine first generation progeny yield. The nature and magnitude of heterosis also helps in identifying superior cross combinations and their exploitation to get desirable transgressive segregants in the advanced generations. Now a days, good progress have been archived in the development of hybrid wheat varieties and several varieties are under testing hence, the knowledge of heterosis would help in determination of parents which produce the best cross combinations having maximum expression of heterosis.

For improving the genetic yield potential of the varieties and hybrids, choice of right type of parents for hybridization is important. This emphasis the importance of testing the parents for their combining ability and their hybrids for manifestation of hybrid vigour, because many-a-times the high yielding parents may not combine well to give good hybrids. Therefore, the success of the useful gene combinations organized in the form of high combining lines and isolation of valuable sources of germplasm id necessary. From this, breeder extract necessary background information with respect to genetic basis of grain yield and its components, nature of gene action and general and specific combining ability of elite parents and their crosses, respectively in the plant breeding programme.

The information on the nature of gene action could be helpful in predicting the effectiveness of selection in a population. The efficient partitioning of genetic variance into its components viz., additive, dominance and their interaction would be help in formulating
Introduction

an effective and sound breeding programme. The cases where cost of hybrids seed is of greater importance, the use of additive gene effects of parents could be used to retain the vigour in subsequent generations.

A distinct knowledge of the type of gene action, its magnitude and composition of genetic variance are of fundamental importance to a plant breeder which helps in formulating an effective and sound breeding programme. Information on nature and relative magnitude of genetic components of variation (additive and dominance) have been generated by diallel analysis or line x tester analysis in wheat which unlike generation mean analysis does not provide information on non-allelic gene actions operating in the inheritance. The non-allelic interaction could inflate the measure of additive and dominance components. It is therefore, important to estimate the components of epistasis along with the additive and dominance components. Such information is limited in wheat especially under both timely and late sown conditions at a time. Estimation of gene effects responsible for grain yield and its components is very useful in selecting appropriate breeding methodology as per the preponderance of genetic components especially for above said sowing conditions.

The present investigation was undertaken adopting line x tester mating technique with the following objectives;

1. To estimate heterobeltiosis and standard heterosis for grain yield and its component traits.

2. To estimate general combining ability (GCA) and specific combining ability (SCA) effects of the parents and crosses, respectively for grain yield and its component traits.

3. To estimate the nature and magnitude of gene action involved in the inheritance of grain yield and its component traits.