1. INTRODUCTION

Chilli or Hot Pepper (Capsicum annuum var. annuum L.) is emerging as one of the most important economical and popular vegetable crops grown for its green fruits as vegetable and red form as spice. Besides, it is used in many processing industries for various products such as pepper sauce, pickled pepper, ground pepper and dried pepper. It belongs to family solanaceae and originated in Latin American regions of New Mexico, Guatemala and Bulgaria (Saffarod 1926). It was first introduced in India from Brazil by the Portugese towards the end of 15\textsuperscript{th} century and its cultivation became popular in the 17\textsuperscript{th} century.

Immature chilli fruits contain phytonutrients, ascorbic acid, caretenoids and rutin which are valued for pharmaceutical needs (Purseglove 1977). Chillies have two important qualities; biting pungency and attractive red colour attributed to capsaicin and capsanthin, respectively. Capsaicin, a crystalline acrid volatile alkaloid present in the placenta of fruit, carries diverse prophylactic and therapeutic uses in allopathic and ayurvedic medicines. Red coloured pigment is used as a natural colour additive in food, drugs and cosmetics. These pigments are also rich in bioflavonoids, which are powerful antioxidants and inhibit the progression of chronic diseases such as muscular degeneration, cardiovascular diseases and cancer. Oleoresin extracted from dried and ground chillies is the total flavour extract which has gained industrial importance through its utilization in processed products and pharmaceutical formulations. Oleoresin is gaining more importance especially from export point of view as it offers uniform quality, longer shelf-life, freedom from micro-organisms and lesser freight charges.

Chilli is presently grown extensively throughout the country, both under rainfed and irrigated conditions, in almost all the states covering an area of 767.23 thousand ha with annual production of 1202.94 thousand metric tonnes (Anonymous 2010). In Himachal Pradesh, the acreage under chilli and bellpepper is 2447 ha with annual production of 31810 metric tonnes.
(Anonymous 2009). India is the leading producer, consumer and exporter of chillies in the world. It exports chilli to USA, UK, Russia, Canada, Italy, Netherlands, Singapore, Saudi Arabia, UAE and Germany in the form of dried pods, chilli powder and oleoresins. The export of 2,04,000 metric tonnes of chilli resulted in earning $ 258 million in 2008 (Anonymous 2008).

India has immense potential to export different types of chillies around the world. However, the average yield is low due to various constraints such as non-availability of suitable cultivars/hybrids, biotic and abiotic stresses and genetic drift in cultivars. In Himachal Pradesh, bacterial wilt (*Ralstonia solanacearum*) has now assumed serious concern in different areas of Kangra, Kullu, Hamirpur and Mandi districts. The disease manifests at all growth stages with maximum severity at flowering and fruiting stage and results in partial to complete failure of crop. Wilt is a soil borne disease which cannot be managed effectively through chemicals. Consequently, development of resistant cultivar(s) remains the most efficient and eco-friendly approach for the management of this disease.

It is, therefore, imperative to carry out genetic studies on gene action involved in the manifestation of important quantitative and qualitative traits for the improvement of yield and breeding resistant lines to the bacterial wilt disease. To stabilize the production, it is also important to breed varieties having wide adaptability under diversified agro-climatic conditions along with resistance to bacterial wilt. Different genotypes react differently to a specific environment or the same genotype gives different response when grown under diverse environments. This indicates that the yield is the result of virtual multiplicative interactions between various component traits. The most appropriate strategy to combine various desirable attributes viz., high yield, resistance to diseases along with responsiveness to better management is the recombinant breeding, the success of which depends upon the ability of the parents to yield desirable recombinants. Therefore, the choice of parents is critical to achieve success (Hallauer and Mirada 1981). Selection of parents on the basis of combining ability, rather than *per se* performance, depends upon the complex interaction among the genes which cannot be judged by the mere yield performance and the
adaptation of the parents (Allard 1960). Moreover, the efficiency of recombinant breeding program would mainly depend upon the genetic architecture of the traits under improvement (Cockerham 1961). An objective judgement about a particular cross likely to produce transgressive recombinant lines in self pollinated crops would mainly depend upon the hybrid vigour and combining ability (Fasoulas 1981) and also on the precise estimates of various genetic components namely, additive, dominance, non-allelic interactions, linkage among the polygenes and gene dispersion in the parents of a cross (Jinks 1983).

To achieve this goal, the line × tester mating design (Kempthorne 1957) is useful in deciding the relative ability of number of female and male inbreds to produce desirable hybrid combinations. This mating design can also provide information regarding the usefulness of the male and female inbreds as parents for hybridization to generate segregating population which is accepted to give prodigious selections. There are several studies based on this mating design in literature but those involving bacterial wilt resistant tester/lines are lacking. To bridge this gap, recombinant breeding has been applied to evolve high yielding lines having resistance to bacterial wilt disease. In addition, the non-availability of genetic mechanism in the present study may not allow exploitation of F₁ hybrids and accordingly the relative magnitude of heterosis can be utilized as a guideline to obtain superior segregants in the later generations having desired constellation of the genes.

Based upon these considerations, the proposed investigation was planned by crossing eleven bacterial wilt susceptible lines with three bacterial wilt resistant testers to achieve the following objectives:

1. To estimate the extent of heterosis and gene action for marketable fruit yield and its component traits,
2. To identify good general and specific combiners for marketable fruit yield and its related traits, and
3. To identify promising hybrids for marketable fruit yield and component traits.