1. INTRODUCTION

Doubled haploids (DHs) are becoming increasingly important in crop breeding programmes and efficient production of doubled haploid plants is of great interest to cereal breeders and geneticists. Since haploid plants carry only one set of alleles at each locus, after chromosome doubling the doubled haploid lines are completely homozygous and homogenous which leads to fixation of desirable characters of recombinants. Doubled haploidy breeding also offers unique advantages to breeders which include saving time, space and labour; development of 100 per cent homozygous lines; small selection population size; elimination of deleterious mutations and weak plant types; useful in development of transgenics; additional variation in the form of gametoclonal variation and elimination of dominant alleles controlling undesirable traits.

The first attempt to use haploidy in breeding appears to be Chase (1949, 1951 and 1952) who selected the low frequency of parthenogenic haploids (egg cell develops into an embryo without fertilization) in maize and then applied chromosome doubling treatment to produce inbred lines. The remarkable discovery that haploid embryos and plants can be produced by culturing anthers of Datura (Guha and Maheshwari 1964 and 1966) brought renewed interest to haploidy breeding. This was quickly attempted in many species but the frequencies were very low, relative to the large numbers of pollen per floret. Then in 1970, Kasha and Kao reported haploid production in barley following wide hybridization and the subsequent preferential elimination of the wild species chromosomes during early embryogenesis. Subsequently, this technique was initiated in wheat with the investigations of Barclay (1975), who recovered wheat haploids in crosses between the wheat variety Chinese Spring and *Hordeum bulbosum*. The technique was, however, genotype specific due to presence of dominant crossability inhibitor genes *Kr1* and *Kr2* in wheat, which are expressed in many wheat varieties and located on 5B and 5A chromosomes respectively (Sitch et al. 1985). Later on, Laurie and Bennett (1987) gave wheat x maize
system of haploid production that was genotype non-specific because of the insensitivity of maize pollen to the action of $Kr1$ and $Kr2$ genes thereby rendering the chromosome elimination technique more efficient and of practical value. Recently, Chaudhary and his associates (2005) and Chaudhary (2007, 2008 a & b and 2010) have invented wheat x *Imperata cylindrica* approach as an efficient alternative to the existing ones for obtaining the high frequency of haploid and doubled haploids in wheat and triticale. *I. cylindrica* (2n=20), a wild weedy perennial grass doesn’t require its repeated sowings and available under natural conditions in almost all parts of the world wherever wheat is cultivated. *I. cylindrica* is a winter season plant and coincides well for flowering with that of wheat and triticale under natural conditions. Hence, raising of greenhouse separately for carrying out crossing programme is not required in this approach. Moreover, *I. cylindrica* is also genotype non-specific for hybridization with any variety of wheat, triticale or their derivatives and pollen of *I. cylindrica* is readily available in abundance during the wheat hybridization period. So, keeping in view the high efficiency and utility of *I. cylindrica* mediated approach in bread wheat, there is a scope to widen its horizon by utilizing this system for the production of doubled haploids in other cereal crops too. Cereal being centrally placed in the human diet, continuous efforts towards improvement endeavours in these crops are must to mitigate the demographically driven expansion of cereal demand that will occur by the year 2025. The estimated cereal demand is 3 billion tonnes for 8 billion population by the year 2025 (Anonymous 2008). The prospects for feeding humanity in the days to come are portrayed in a daunting light as the world’s population are growing faster than cereal production. So, continued breeding improvement of cereal crops using both conventional as well as biotechnology research tools like haploidy breeding is imperative and such endeavours must go on in order to combat food insecurity, hunger & poverty, thereby secure peace and prosperity.

Recently, the chromosome elimination – mediated approach of doubled haploidy (DH) breeding has extensively been brought in use to accelerate the bread wheat improvement endeavours in many labs across the world. Although it
is considered as a very innovative tool for enhancing the precision and efficiency of wheat breeding efforts yet, the low efficiency of development of DH populations has limited the exploitation of this technique in crop improvement. In all the methods employed to obtain doubled haploid plants viz., bulbosum technique, wheat x maize system and wheat x I. cylindrica system, higher mortality rate of haploid plants due to lethal action of colchicine hampers the appreciable recovery of doubled haploids (DHs). This limitation necessitates looking for other alternatives of colchicine application at in vivo and in vitro level.

So, keeping in view, the scope to widen the horizon of I. cylindrica mediated approach for production of doubled haploids in other cereal crops and handling hurdling impacts of colchicine, this research endeavour has been proposed which may provide an opportunity to eliminate the constraint of lethality of colchicine to some extent and enhance the efficiency of DHs production in wheat as well as in other gramineae genera too. The investigation was undertaken with the following objectives:

To

- induce haploids in wheat, barley, rice, maize and oat through wide hybridization with I. cylindrica as a pollen source and
- enhance doubled haploid production efficiency of the wheat x I. cylindrica through colchicine manipulations at the in vivo and in vitro level.