1. INTRODUCTION

Among the food grain crops of the world, wheat (*Triticum aestivum* L. em Thell) is pre eminent both in regards to its antiquity and importance as a food of mankind. Globally it occupies the top most position among the cereal crops with respect to area (225.62 million hectares) and production (680.00 million metric tons) (Anonymous 2010). India ranks first in the wheat acreage (27.90 million hectares) and second in the production (80.68 million metric tones) in the world (Anonymous 2010).

There has been a tremendous increase in wheat production in our country since the times of the Green Revolution. This has been possible with the introduction of the dwarf wheat genotypes carrying the dwarfing genes *Rht-B1b* and *Rht-D1b* from Norin-10-Brevor-14 background (Borner *et al.* 1996) and the genes for photo-insensitivity from the Mexican spring wheat. This led to overall genetic upgradation of wheat, leading the nation to reach the status of self sufficiency. However, at present, the wheat production has almost reached a plateau and another break through is required in order to meet the ever-increasing food demand of the nation. In the hill states of the country, wheat is generally grown under diverse and rainfed conditions. Thus, drought becomes the major constraint, followed by cold stress and susceptibility to various diseases, which drastically reduce the production of wheat in these areas. Therefore, the breeding objectives must be essentially comprised of the development of high yielding varieties resistant to drought and other biotic (rusts and powdery mildew) and abiotic (cold) stresses. The resistance to these stresses can be incorporated from certain potential sources like winter wheat and rye (*Secale cereale*).

Rye (*Secale cereale* L.) is a good source of genes for resistance to these stresses. The important traits that can be incorporated into the bread wheat from rye are resistance to wheat rusts, particularly stripe rust (*Puccinia striiformis*), Karnal bunt (*Tilletia foetida*), powdery mildew (*Erysiphe graminis* f.sp. *tritici*) and barley yellow dwarf virus (BYDV); tolerance to drought, cold and soil acidity, low input and cultural requirements, high P-uptake efficiency, high copper uptake under copper deficient soils; high protein and lysine content in grains; profuse tillering and long spike with the large number of spikelets per spike and desired novel traits resulting from intergenomic interactions (Sethi 1989). Therefore, this gene pool may be harnessed for the enrichment of spring wheat cultivars through alien gene transfer.
Triticale (x *Triticosecale* Wittmack), the first man made cereal as a result of cross between wheat (*Triticum aestivum*) and rye (*Secale cereale*), may be used as bridging species to accomplish this goal since it easily hybridizes with wheat. Because of their complement of rye chromosomes, triticales have agronomic attributes that are not found in wheat (Merker 1984). The gene pool of triticale can thus be incorporated into the wheat background to combine uniform grain quality, production and chapatti-making quality of wheat with disease resistance and nutritional quality of rye. Careful selection of parents is required on the part of breeders for the success of triticale x wheat hybridization programmes to isolate potential recombinants from the segregating populations. The time, space and labour requirements for raising the segregating generations of crosses render such breeding programmes very costly. However, to achieve quick and desirable results, the various haploid breeding procedures have immense significance and practical utility as compared to the conventional breeding approaches.

*In vitro* haploid production through anther culture or intergeneric hybridization with Maize (*Zea mays* L.) and Cogon grass (*Imperata cylindrica*), followed by chromosome doubling by colchicine treatment leads to the production of completely homozygous plants in just a single step (1 year), whereas conventional breeding approach takes much time (7-8 years) for the isolation of stable lines from the crosses. Further, the gametoclonal variation arising through androgenesis may also supplement the selection programme and we also need not grow large populations of haploid plants since selection is possible on the basis of gametic frequency. Haploid breeding approach also increases the correctness of selection of multiple crosses in comparison to the traditional methods besides having use in mutation breeding as the homozygous constitution of gametes allows dominant as well as recessive mutations to be expressed directly among haploid regenerants and the deleterious mutations are not recovered. The rye genome has shown potential for improvement of bread wheat, where wheat-rye substitutions and translocations have been and are frequently used in resistance breeding (Rabinovich 1998) and the 1B/1R wheat-rye translocation is present in the highest yielding cultivars currently grown in many parts of the world (Heslop-Harrison *et al.* 1990). The process of obtaining homozygous populations from the triticale x wheat hybrids and their back-crosses can be accelerated by utilizing doubled haploidy breeding (DH) following chromosome elimination approach through *Zea mays* - and *Imperata cylindrica*-mediated
systems. There is a dire need to further enhance the precision and efficiency of selection amongst the newly developed wheat recombinants for identifying alien chromatin/genes introgressed with minimum linkage drag. Molecular cytogenetics offer various powerful and novel tools such as genomic in situ hybridization (GISH) and fluorescence in situ hybridization (FISH) which can help in physical mapping of the introgressed chromatin/genes into wheat genome.

Keeping in view the above, the present investigation has been proposed with the objectives to:

i. develop triticale x wheat derived doubled haploids of wheat involving elite triticale and wheat lines following chromosome elimination approach through Zea mays – and Imperata cylindrica – mediated systems and

ii. detect and characterize the rye chromatin introgressed into triticale x wheat derived wheat recombinants (developed through DH breeding and conventional breeding approaches) through fluorescence in situ hybridization and sort out wheat like recombinants having the desired rye chromatin with minimum linkage drag.