SUMMARY
Wheat is one of the most important cereal in the Indian subcontinent and rusts are the major biological constraints in increasing wheat production. As these are air-borne and can spread to far-off places, epidemics can only be avoided by the manipulation of host resistance genes. Therefore, the use of resistant cultivars offers the most effective form of disease control. The present studies were conducted on two widespread and destructive diseases of wheat, i.e. brown rust caused by *Puccinia recondita* f.sp. *tritici* and yellow rust caused by *P. striiformis*, considering the following objectives:

1) To characterise *Lr* and *Yr* (leaf rust and yellow rust resistance) genes in selected wheat material of India on the basis of gene matching technique.

2) To study the Adult Plant Resistance (APR) of some wheat lines against brown and yellow rusts.

3) To attempt characterisation of *Lr12, Lr21, Lr22b* etc. in Indian wheat material.

4) To study the phenomenon of slow-rusting in some wheat lines.

5) To study temperature sensitive resistance of different wheat lines.

6) To study variation in different rust pathogens/pathotypes at the DNA level through PCR (Polymerase Chain Reaction).

The results of the present investigation are summarized in the following pages:

Out of 83 Indian wheat cultivars used in the study, brown rust resistance genes could be characterised in 60 cultivars which comes to 72.3% of the cultivars. The resistance gene *Lr26* was detected in 23 cultivars, *Lr23* in 20, *Lr13* in 18, *Lr10*, *Lr1* and
$Lr_{24}$ in 4 each and $Lr_{9}$ in 1 cultivar which exhibited differential host-pathogen interactions.

Differential host-pathogen interaction against yellow rust pathotypes could be recorded only in 73(88%) cultivars but $Yr$ genes could be postulated in 44(53.0%) cultivars. $Yr_{9}$, $Yr_{2}$ (KS+) and $Yr_{2}+$ were recorded in 23(52.3%), 12(27.3%) and 9(20.5%) cultivars, respectively.

Out of these 83 cultivars, 9 were found to be resistant to all the pathotypes of *Puccinia recondita f.sp. tritici* and 6 to pathotypes of *P. striiformis*.

The two cultivars HP 1761 and HW 1085 which were found to be resistant to all the pathotypes of brown rust but produced characteristic infection types similar to $Lr_{26}$, were analysed cytologically. These studies revealed the existence of two satellited chromosomes instead of four out of a total of 42 chromosomes in the somatic cells of two cultivars namely, HP 1761 and HW 1085 which confirmed the presence of linked genes $Lr_{26}/Sr_{31}/Yr_{9}$.

All wheat lines from Turkey except TY81V-6603-3 expressed differential host-pathogen interactions but $Lr$ genes could be postulated in 20(55.6%) lines only, $Lr_{1}$ and $Lr_{3}$ being most commonly postulated genes in 8 lines each. Rust resistance genes $Lr_{26}$ and $Lr_{13}$ were present singly or in combination with other genes in 4 lines each whereas $Lr_{10}$ could be characterized in 2 and $Lr_{23}$ in 1 line(s).

Out of 83 Indian wheat cultivars, 10 cultivars were found to possess APR against pt. 1R5, 9 to pt. 121R63-1 and 14 to pt. 21R55. All these pts. are most predominant
pathotypes in India. However, cultivar GW 173 showed APR to all the three pathotypes studied whereas three cultivars HD 2402, JWS 17 and RAJ 3765 possessed APR against two pathotypes 1R5 and 21R55. APR to pts. 1R5 and 121R63-1 was exhibited by cultivar KRL19 whereas cultivar PBW 373 exhibited APR to pts. 121R63-1 and 21R55.

In case of yellow rust, 15 and 23 cultivars showed APR against pts. 46S103 and 46S119, respectively, whereas 8 cultivars expressed APR against both the pathotypes namely, 46S103 and 46S119.

Screening of near-isogenic lines revealed the existence of APR in Lr12, Lr21 and Lr37 against pts. 1R5, 121R63-1 and 21R55, the most predominant and prevalent pathotypes of brown rust whereas near isogenic lines Lr10 and Lr13 exhibited APR against pts. 1R5 and 21R55, Lr22a against pts. 1R5 and 121R63-1 and Lr14a and Lr22b against pt. 1R5 only.

Twelve wheat cultivars of North Western Plain Zone were evaluated against four pathotypes out of which two are known to possess virulence for Lr26 and avirulence for Lr23 i.e. 5R37 and 109R63 and two pathotypes virulent on Lr23 but avirulent on Lr26 i.e. 109R31-1 and 29R23. Wheat cultivars K 9107 was found to possess APR against pts. 5R37 and 109R31-1, GW 173 to pts. 109R31-1 and 29R23 and HS 295 to pts. 109R63 and 109R31-1. In addition, cultivars PBW373, PDW233 and UP2338 expressed APR against pt. 5R37, PBW396 against pt. 109R63 and HD2402 against pathotype 29R23.

Similarly, among wheat lines from Turkey, line ERITH 15236 exhibited APR against three pathotypes namely 109R31-1, 121R63-1 and 21R55, SULTAN-95 to pts.
1R5, 121R63-1 and 21R55, N-921010 and RENAN to pts. 1R5, 109R31-1 and 21R55 and Co.724377 to pts. 1R5 and 21R55. In addition, KHVXLYA was observed to express APR against pt. 1R5, F-4141-WI-133 to pt. 121R63-1 and SERI-82 to pt. 21R55.

Among the Indian wheat cultivars, HS 365 exhibited highest slow-rusting resistance at seedling stage against pt. 121R63-1 and HPW 42 against pt. 21R55 whereas at the adult plant stage, VI. 804 possessed highest slow-rusting resistance against pt. 121R63-1 and K 9465 against pt. 21R55.

Among the Australian lines, RL 6059 exhibited highest slow-rusting resistance at seedling stage against pt. 121R63-1 and CHRIS against pt. 21R55 whereas RL6059 showed highest slow-rusting mean ranking at the adult plant stage against both pts. 121R63-1 and 21R55.

However, the near isogenic line Lr34 exhibited slow-rusting resistance at both seedling and adult plant stages against both the pts. 121R63-1 and 21R55.

Wheat lines viz., HUW 468, K 9465, PBW 396 and SONALIKA and near isogenic lines Lr21, Lr24 along with Webster (Lr2a) showed pathotype specific temperature sensitivity as evidenced by variation in ITs at different temperatures.

Random Amplified Polymorphic DNA (RAPD) analysis revealed variation among the four pts. 121R63-1, 0R9, 46S102 and 46S103, studied with the help of six high GC primers, CRL 20, CRL 21, CRL 22, CRL 26, CRL 27 and CRL 28.
In case of brown rust pts. 121R63-1 and 0R9, DNA polymorphism was observed with only primer CRL 28 whereas pts. 46S102 and 46S103 showed variation between them with primers CRL 27 and CRL 28.

Thus, the different sources of rust resistance for incorporation in wheat lines have been investigated in the present studies. The wheat lines in which brown and yellow rust resistance genes were postulated can be deployed in different areas to avoid rust epiphytotics. Lines with adult plant resistance factors can be used in breeding programme to develop resistant cultivars. Sources of resistance found in Turkish and Australian wheat lines can be incorporated in the Indian wheat material for the diversification of resistance. Moreover, resistance in the wheat lines possessing characters which slow down rust development, can also be incorporated in the lines lacking slow-rusting resistance for reducing terminal disease severity. Some wheat lines showing pathotype specific temperature sensitivity can also be deployed in wheat growing areas so as to avoid rust infection. The different pathotypes of rusts are used as ‘tools’ in the identification of rust resistance. It can also be inferred that variation among rust pathotypes occurred at DNA level and can be observed with the help of Polymerase Chain Reaction by RAPD analysis.