The present investigation was designed to elucidate the Genetics of Resistance in *T. castaneum* by developing deltamethrin resistant strains in laboratory and then understanding the underlying mechanism of insecticide resistance.

In the present study for the establishment of culture in the laboratory adults of *Tribolium castaneum* were collected from two different areas of the city of Agra, Dayalbagh and Cantonment area and pooled together to have a heterogeneous population with large variability. The progeny thus reared in the laboratory was designated as parental strain (P1) with which the selection for resistance study was initiated and their cytogenetic and nonspecific esterase patterns were also standardized.

In cytogenetic analysis the karyotype of *T. castaneum*, showed a diploid number of 2n = 20 chromosome and sex determining mechanism was of “parachute type” due to the X and y chromosome (9AA + Xy_p). C- banded preparations showed positive staining in centromeric regions of all autosomes. In sex chromosomes only Xp chromosome indicated heterochromatised block. Nucleolar organizing regions were also utilized as cytogenetic marker. In isozyme studies three functional zones of nonspecific esterase activity have been detected in the adults of *Tribolium castaneum*. EST-1 is highly anodal while EST-3 is cathodal. These patterns of chromosomes and nonspecific esterase were used as a standard pattern of *T. castaneum* in further studies with resistant population for comparative analysis.

The selection of insects for resistance was initiated by ascertaining the dose which gave about 70% mortality of susceptible individuals in each generation by topical application method. Following deltamethrin selection for six generations, the level of resistance to deltamethrin in RTF_6 strain is 370.5-fold in compared to susceptible strain. High levels of resistance to pyrethroid insecticide in *Tribolium* resistant strains were conferred by chromosomal aberrations and hydrolase (esterase)-mediated detoxification.

This study has, for the first time, reported chromosomal aberrations in different generations of resistant strains of *Tribolium* during the course of deltamethrin selection. The chromosomal abnormalities encountered during the study varied from
polyploidy, dicentric, triradial, ring formation, bridge, breaks, wooly appearance, elongation, clumping, reciprocal translocation, interarm interchange, somatic reduction and corrosive effect. The increased trend in the percentage of aberrant cells and in the number of CAs per generation was similar as the results shown in bioassay at different resistant generations. In all resistant generations, significantly higher effects were seen in highly resistant generation (RTF<sub>6</sub>).

Esterase base metabolic resistance was studied by polyacrylamide gel electrophoresis. The result indicates that the difference in esterase activity between resistant and susceptible strains is caused by high intensity of EST-1a and EST-1b bands. These bands were more intense in the RTF<sub>6</sub> strains. The difference in intensity between populations indicates a quantitative mechanism of resistance involving over-production of the same enzyme that is present in susceptible insects. This is in accordance with the results of bioassay in which resistance ratio was greater in RTF<sub>6</sub> strain. With cytogenetical and isozymal markers some morphological mutants at pupal stage were also observed in RTF<sub>6</sub> generation. When compared to normal pupa they showed shiny transparent white skin, extra pair of antennae, enlargement of body segments, reduced size of elytra.

Genetic crosses were made between susceptible and highly resistant Tribolium strain to confirm that the resistance developed in the present study have genetic base and inheritance analysis were carried out to determine their degree of resistance, Toxicological analysis including bioassay and non specific esterase isozyme as genetic marker was also utilized in inheritance analysis. The results of this study indicates resistance to deltamethrin of the F<sub>1</sub> progenies of R x S and S x R crosses had fallen in the mid parent range (D of LC<sub>50</sub> for these crosses 0.895 and 0.847 respectively). The value of SF X RM was less than RF X SM which indicated that the female was responsible for the resistance, this indicates that resistance was autosomal and inherited by incompletely dominant or partially dominant gene. Data on enzymatic studies also supports the results of toxicity analysis. Morphological changes in pupa also showed that these genes are also associated with the phenotypic expressions responsible for body size and cuticle. Result of the present study revealed that inheritance of resistance to deltamethrin in Tribolium castaneum was derived by incomplete dominant genes and are autosomally linked.