

# **Genetics of low temperature tolerance in maize (*Zea mays* L.)**

**By**

**Saira Bano**

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**Co-Supervisor**

\_\_\_\_\_  
(Dr. Khalid Aziz)

**Member**

\_\_\_\_\_  
(Pro. Dr. Muhammad Saleem)

**Member**

\_\_\_\_\_  
(Prof. Dr. Shahzad M. A. Basra)

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***DEDICATED***

**TO**

***MY Parents and Respected Teachers***



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## LIST OF ABBRIVATIONS

[d] = Additive  
[h] = Dominance  
[i] = Additive × additive  
[j] = Additive × dominance  
[l] = Dominance × dominance  
100GW=100 grain weight  
AA=Ascorbic acid  
APX=Ascorbate peroxidase  
ASI=Anthesis-silking interval,  
BC<sub>1</sub>=Backcross one  
BC<sub>2</sub>= Backcross two  
Caro= $\beta$  carotenoids,  
Chl *a*=Chlorophyll *a*,  
Chl *b*)=Chlorophyll *b*,  
DTS=Days to silking,  
DTT=Days to tasseling,  
E=Transpiration rate,  
E<sub>50</sub>=Time to 50% emergence  
EI=Emergence index,  
F<sub>1</sub>=First Filial generation  
F<sub>2</sub>=2<sup>nd</sup> Filial generation  
FEP=Final emergence percentage,  
GPC=Number of grains per cob,  
GR=Glutathione Reductase  
G<sub>s</sub>=Stomata conductance,  
GYPP=Grain yield per plan  
LFW=Leaf fresh weight,  
LT=Leaf temperature  
m =Mean effects  
MET=Mean emergence time  
NARC=National Agricultural Research Centre  
P<sub>1</sub>=1<sup>st</sup> Parent  
P<sub>2</sub>=2<sup>nd</sup> Parent  
PAR=Photosynthetic active radiation  
PCA=Principal Components Analysis  
PGRI= Plant Genetic Resources Institute  
PH=Plant height  
Pro=Proline  
R=Rank  
RDW=Root dry weight  
RFW=Root fresh weight

RL=Root length  
RSR=Root-shoot ratio  
SA=Salicylic Acid  
SDR=Standard deviation of ranks  
SDW=Shoot dry weight  
SFW=Shoot fresh weight  
SL=Shoot length  
SL=Shoot length  
SOD=Superoxide Dismutase

## ABSTRACT

Maize (*Zea mays* L.) is a crop of tropical and subtropical origin. Therefore is more sensitive to low temperature stress as compared to crops of temperate origin. Spring season maize is facing the problem of low temperature stress at early growth stages. To search for tolerance among available maize germplasm, to determine the mode of gene action involved in the control of different parameters related to low temperature stress tolerance and to assess the extent of association of different parameters with grain yield, the current study was planned. Maize genotypes were screened under controlled conditions of greenhouse and natural stress conditions of field by following completely randomized design and triplicated split plot design respectively. In greenhouse experiment, the genotypes were evaluated under normal and low temperature stress environment. The temperature was adjusted at 11/9 °C (day/night). Whereas, in field conditions, natural low temperature stress was managed by early sowing (1<sup>st</sup> week of January) and normal set was sown in 1<sup>st</sup> week of February. In greenhouse conditions, seedlings were uprooted to study phenological and biochemical traits like mean emergence time, time to 50% emergence, final emergence percentage, emergence index, shoot length, root length, root-shoot ratio, root shoot fresh and dry weights,  $\beta$  carotenoid contents, chlorophyll *a* and *b* contents, proline contents and ascorbic acid contents to screen out tolerant and susceptible genotypes in greenhouse. Under field conditions, in addition to all above traits, data were recorded for plant height, leaf fresh weight, stomata conductance, leaf temperature, transpiration rate and photosynthetic active radiation. Yield attributing traits like days to tasseling, days to silking, anthesis-silking interval, number of grains per cob, 100 grain weight along with grain yield per plant were recorded. On the basis of performance in both the experiments genotype 014888 was ranked as most tolerant and E-326 as most susceptible. Both, most tolerant and most susceptible genotypes were used as parents in hybridization program of generation mean analysis. Generations P<sub>1</sub>, P<sub>2</sub>, F<sub>1</sub>, F<sub>2</sub>, BC<sub>1</sub> and BC<sub>2</sub> were raised and evaluated in greenhouse and field under both low temperature stress and normal conditions to find gene expression involved in the control of low temperature stress related traits. Generation means analysis showed that all three types of genetic effects (additive, dominance and interactions) contributed in inheritance of traits for low temperature stress. Association among yield contributing traits was computed to know the interrelationship among them. On the basis of information drawn from experiments done in screening phase, computation of correlation and genetic effects, it is concluded that genetic diversity among maize germplasm is quite evident at allelic level and there is available genetic potential to improve low temperature stress tolerance in maize. The additive and epistatic effects in the control of different low temperature stress related traits can be exploited in different breeding programs to improve maize genetic potential against chilling stress.