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

By

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M. Sc. (Hons) Agri.

2004-ag-1441

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE

REQUIREMENT FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

Plant Breeding & Genetics

DEPARTMENT OF PLANT BREEDING AND GENETICS
FACULTY OF AGRICULTURE
UNIVERSITY OF AGRICULTURE, FAISALABAD
(PAKISTAN)

2015

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MY Parents and Respected Teachers

Acknowledgements

It is complicated to overstate my thanks to my worthy supervisor, **Dr. Muhammad Aslam** Assistant Professor, Dept. of Plant Breeding & Genetics, University of Agriculture Faisalabad, for his skillful guidance, constructive criticism, masterly advice, valuable suggestions and sympathetic behavior for the completion of this manuscript. It was certainly a matter of pride to work under his guidance.

I wish to acknowledge my supervisory committee **Dr. Muhammad Saleem**, Professor, Dept. of Plant Breeding and Genetics, **Dr. Shahzad M. A. Basra**, Professor, Dept. of Agronomy, University of Agriculture, Faisalabad and **Dr. Khalid Aziz**, Raphan Maize Pvt. Limited, Faisalabad. I am grateful for their inspiring direction, keen interest, scholarly comments and beneficial suggestions throughout the course of my studies.

I wish to thank my entire family for providing a loving and supportive environment for me. They always helped me in solving all of my troubles with their love, affection, inspiration, and boosted my moral to fly high to accomplish my goal, and every time wished to see me glittering up on the skies of success.

I am grateful to my friends and colleagues who supported me a lot during my studies. I pay my cordial thanks to those who live in my mind and soul, whose love will never mitigate, whose prayers will never die, who are nearest, deepest and dearest to me, my parents, brothers and sister who helped me ever in the life. I am thankful to **Higher Education Commission (HEC)** Pakistan for supporting me to complete my PhD studies.

Saira Bano

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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_1=Backcross one
BC_2= Backcross two
Caro=β carotenoids,
Chl *a*=Chlorophyll *a*,
Chl *b*)=Chlorophyll *b*,
DTS=Days to silking,
DTT=Days to tasseling,
E=Transpiration rate,
E_{50}=Time to 50% emergence
EI=Emergence index,
F_1=First Filial generation
F_2=2nd Filial generation
FEP=Final emergence percentage,
GPC=Number of grains per cob,
GR=Glutathione Reductase
G_S=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_1=1st Parent
P_2=2nd 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 screenhouse and natural stress conditions of field by following completely randomized design and triplicated split plot design respectively. In screenhouse 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^{st} week of January) and normal set was sown in 1^{st} week of February. In screenhouse 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, β carotenoid contents, chlorophyll *a* and *b* contents, proline contents and ascorbic acid contents to screen out tolerant and susceptible genotypes in screenhouse. 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_1, P_2, F_1, F_2, BC_1 and BC_2 were raised and evaluated in screenhouse 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.