

**GENETIC STUDIES AND SELECTION FOR EAR LENGTH OF SWEET CORN
(*Zea mays* L.)**

By

MANDEFRO NIGUSSIE WOLDEMARIAM

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of
Doctor of Philosophy**

October 2004

DEDICATION
TO MY PARENTS AND FAMILY

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirements for the degree of Doctor of Philosophy

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Chairman : Professor Ghizan Saleh, Ph.D.

Faculty : Agriculture

This study was conducted to investigate the effects of introgression of exotic germplasm into elite local sweet corn populations, and to determine the genetic responses to two cycles of mass and selfed progeny selections on two sweet corn populations after introgression.

At the initial stage of this study, two elite local sweet corn populations (BC1-10 and BC1-9) were crossed to two exotic synthetic populations (Syn-I and Syn-II). The resulting population crosses and their parents were evaluated for performance in comparison with two check varieties. Subsequently, two superior populations, BC1-10 x Syn-II and BC2-10, which revealed high performance, were selected and used as base populations to initiate selection experiments.

In the selection experiments, two cycles of mass selection (MS) and selfed progeny selection (SPS) for ear length were conducted on BC1-10 x Syn-II and BC2-10 at the Institute of Bioscience Farm, Universiti Putra Malaysia (UPM). The improved populations generated from the two base populations through MS and SPS, were evaluated with the base populations at two locations, the University Agriculture Park and the Institute of Bioscience Farm, in UPM.

In BC2-10 derived populations, the predicted responses to MS were 24.7% in C1 and 18.8% in C2, whereas the predicted responses to SPS were 13.2% in C1 and 9.8% in C2. A similar trend was shown in BC1-10 x Syn-II derived populations, where the predicted responses to MS were 22.3% in C1 and 16.0% in C2, while the predicted responses to SPS were 9.9% in C1 and 8.3% in C2.

The improved populations generated from the two base populations showed varied average realized responses to the two cycles of MS and SPS conducted. In BC2-10 derived populations, the realized responses to MS were 5.1% in C1 and 4.8% in C2, whereas the realized responses to SPS were 9.1% in C1 and 1.2% in C2. In BC1-10 x Syn-II derived populations, the realized responses to MS were 5.5% in C1 and 2.9% in C2, while the realized responses to SPS were 5.6% in C1 and 2.9% in C2.

Based on the mean values over both locations, BC2-10 MS C2 revealed higher husked fresh ear yield (13 864 kg/ha), dehusked fresh ear yield (11 115 kg/ha), husked ear length (24.6 cm), dehusked ear length (17.1 cm), husked ear diameter (46.7 mm), and number of kernels per row (42.9) than the base population (BC2-10 C0) which had mean values of 12 350 kg/ha, 10 229 kg/ha, 23.7 cm, 16.0 cm, 45.1 mm and 39.1 for the same traits, respectively. A similar trend was observed on BC1-10 x Syn-II MS C2 which revealed higher dehusked fresh ear yield (10 616 kg/ha) than the base population (BC1-10 x Syn-II C0) which had 9 654 kg/ha.

Ear length, which was used as the selection criterion in this study, showed high broad-sense heritability in BC2-10 and BC1-10 x Syn-II derived populations, while dehusked fresh ear yield revealed low heritability, indicating that selection for ear length if conducted on these populations in the succeeding generations would be more effective than selection for fresh ear yield.

Based on data across locations, fresh ear yield showed strong positive correlations with ear length and ear diameter, indicating that, selection for any of these traits could produce improvement of fresh ear yield.

The results of this study have indicated that introgression of exotic germplasm into elite local populations had effectively increased earliness in flowering, shortness of plants, kernel sweetness and yield in the population cross BC1-10

x Syn-II. The two cycles of MS and SPS conducted on BC2-10 and BC1-10 x Syn-II were effective in improving ear length and some correlated traits. Further selection on these populations could offer better responses in the succeeding generations.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KAJIAN GENETIK DAN PEMILIHAN UNTUK KEPANJANGAN TONGKOL
PADA JAGUNG MANIS (*Zea mays* L.)**

Oleh

MANDEFRO NIGUSSIE WOLDEMARIAM

Oktober 2004

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Kajian ini dijalankan untuk menyelidik kesan penggabungan germplasma dari luar terhadap populasi jagung manis elit tempatan, dan menentukan tindakbalas genetik terhadap dua pusingan pemilihan kasar serta pemilihan progeni penyendirian ke atas dua populasi jagung manis.

Di peringkat awal kajian, dua populasi jagung manis elit tempatan (BC1-10 dan BC1-9) telah dikacukkan dengan dua populasi sintetik dari luar (Syn-I dan Syn-II). Populasi kacukan yang terhasil dan populasi-populasi induknya telah dinilai prestasi bersama dengan dua varieti kawalan. Seterusnya, dua populasi unggul, BC1-10 x Syn-II dan BC2-10, yang mempamerkan prestasi yang tinggi, telah dipilih dan digunakan sebagai populasi bes untuk memulakan kajian pemilihan.

Di dalam kajian pemilihan, dua pusingan pemilihan kasar (MS) dan pemilihan progeneri penyendirian (SPS) untuk kepanjangan tongkol telah dijalankan terhadap BC1-10 x Syn-II dan BC2-10 di Ladang Institut Biosains, Universiti Putra Malaysia (UPM). Populasi maju yang terhasil dari kedua-dua populasi bes melalui MS dan SPS, telah dinilai bersama populasi-populasi bes tersebut pada dua lokasi, iaitu Taman Pertanian Universiti dan Ladang Institut Biosains, UPM.

Dalam populasi yang terhasil dari BC2-10, tindakbalas yang diramal untuk MS ialah 24.7% bagi C1 dan 18.8% bagi C2, manakala tindakbalas yang diramal terhadap SPS pula ialah 13.2% bagi C1 dan 9.8% bagi C2. Tren yang serupa ditunjukkan dalam populasi yang terhasil dari BC1-10 x Syn-II, di mana tindakbalas yang diramal terhadap MS ialah 22.3% bagi C1 dan 16.0% bagi C2, manakala tindakbalas yang diramal terhadap SPS ialah 9.9% bagi C1 dan 8.3% bagi C2.

Populasi maju yang terhasil dari dua populasi bes tersebut menunjukkan purata tindakbalas sebenar yang berbeza terhadap dua pusingan MS dan SPS yang dijalankan. Dalam populasi yang terhasil dari BC2-10, tindakbalas sebenar terhadap MS ialah 5.1% bagi C1 dan 4.8% bagi C2, manakala tindakbalas sebenar terhadap SPS ialah 9.1% bagi C1 dan 1.2% bagi C2. Dalam populasi yang terhasil dari BC1-10 x Syn-II, tindakbalas sebenar terhadap MS ialah

5.5% bagi C1 dan 2.9% bagi C2, manakala tindakbalas sebenar terhadap SPS ialah 5.6% bagi C1 dan 2.9% bagi C2.

Berasaskan nilai purata kedua-dua lokasi, BC2-10 MS C2 mempamerkan prestasi yang lebih tinggi bagi hasil tongkol segar dengan kulit (13 864 kg/ha), hasil tongkol segar tanpa kulit (11 115 kg/ha), panjang tongkol dengan kulit (24.6 cm), panjang tongkol tanpa kulit (17.1 cm), diameter tongkol dengan kulit (46.7 mm) dan bilangan biji per baris (42.9), berbanding populasi bes (BC2-10 C0) yang mempunyai nilai purata 12 359 kg/ha, 10 229 kg/ha, 23.7 cm, 16.0 cm, 45.1 mm dan 39.1, masing-masing bagi ciri yang serupa. Tren yang serupa dilihat pada BC1-10 x Syn-II SPS C2 yang mempamerkan hasil tongkol segar tanpa kulit yang lebih tinggi (10 616 kg/ha) berbanding populasi bes (BC1-10 x Syn-II C0) yang memperolehi 9 654 kg/ha.

Kepanjangan tongkol, yang digunakan sebagai kriteria pemilihan dalam kajian ini, menunjukkan nilai kebolehwarisan luas yang tinggi dalam populasi yang terhasil dari BC2-10 dan BC1-10 x Syn-II, manakala hasil tongkol segar tanpa kulit pula mempamerkan kebolehwarisan yang rendah, menunjukkan bahawa pemilihan berdasarkan kepanjangan tongkol, sekiranya dijalankan ke atas populasi ini di dalam generasi seterusnya, adalah lebih berkesan berbanding pemilihan berdasarkan hasil tongkol segar.

Berdasarkan data dari kedua-dua lokasi, korelasi positif yang kuat antara hasil tongkol segar menunjukkan dengan kepanjangan tongkol dan diameter tongkol, menjelaskan bahawa, pemilihan untuk mana-mana sifat ini berupaya meningkatkan penghasilan tongkol segar.

Keputusan kajian ini telah menunjukkan bahawa penggabungan gemplasma dari luar ke dalam populasi elit tempatan telah meningkatkan keawalan pembungaan, kerendahan pokok, kemanisan biji serta hasil di dalam populasi kacukan BC1-10 x Syn-II secara berkesan. Dua pusingan MS dan SPS yang dijalankan terhadap BC2-10 dan BC1-10 x Syn-II berkesan di dalam meningkatkan kepanjangan tongkol dan beberapa ciri lain yang berkait. Pemilihan seterusnya terhadap populasi ini boleh memberikan tindakbalas yang lebih baik di dalam generasi seterusnya.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to my major supervisor, Professor Dr. Ghizan Saleh for his counsel and advice. He provided me his boundless knowledge, constructive suggestions and constant encouragement throughout the course of my study. In spite of his task of teaching, research work and administrative responsibility, he has virtually made himself available to me and offered me limitless guidance that enabled me to produce this thesis within a short time. Prof. Ghizan is genuine and tireless upon consultation.

I am highly indebted to Associate Professor Dr. Zakaria Wahab and Dr. Uma Rani Sinniah, members of the supervisory committee, for their constant discussion, encouragement and constructive suggestions throughout my study.

My sincere appreciation also extends to my fellow graduate and undergraduate students in the plant breeding laboratory, staff of Institute of Bioscience, Field 2 and the University Agriculture Park, without whose help this study could not have been completed on time. To mention some, Dr. Eltahir Siddig Ali, Mr. Khayamuddin Panjaitan, Mr. Panca Jarot Santoso, Mrs. Maininah Tahir, Mr. Iden Ismail, Ms. Nor Aishah Abdul Razak, Ms. Rosnaini Hamzah, Mr. Nummeran Mohd. Nordin, Mr. Tajuddin Abdul Manap, Mr. Shahril Abdul Rahman and Ethiopian students at UPM during 2002-2005.

I also thank the Ethiopian Agricultural Research Organization for the financial support, and staff of Melkasa Agricultural Research Center (MARC) for their consistent moral support. Special thanks go to Dr. Aberra Deressa, the director of MARC, and Maize Research staff at MARC.

Alemaya University of Agriculture (AUA), is a place where I earned my B.Sc. and M. Sc. degrees and stubbed my toes with a plenty in traveling over the rocky roads of academic journey. Dr. Habtamu Zelleke and Prof. Dr. V.P. Gupta of AUA added academic depth and multi-institutional insight that was leavening and invaluable.

Finally, I would like to express my heartfelt thanks to my parents who cultivated and brought me up with delight and strong moral support throughout my academic career. I highly appreciate my wife Abebech Mulisa for her patience, encouragement and managing the family during my study. My brother and all my sisters are offered special thanks for visiting and assisting my family and encouraging me during my study.

All of you played a vital role in my academic life. Therefore, I offer the best I can give: my humble and hearty thanks.

I certify that the Examination Committee met on 11th October 2004 to conduct the final Examination of Mandefro Nigussie Woldemariam on his Doctor of Philosophy thesis entitled “Genetic Studies and Selection for Ear Length of Sweet Corn (*Zea mays* L.)” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or any other institutions.

MANDEFRO NIGUSSIE WOLDEMARIAM

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