Abstract

COETZEE, MICHEL CHRISTIAAN BROOKS. Temperate and sub-tropical maize germplasm: Heterotic patterns, combining ability and genetic similarities. (Under the direction of Major M. Goodman).

This study emphasizes two viewpoints: 1) The narrow germplasm base of commercial US maize (Zea mays L.) and the potential of South African germplasm to contribute to broadening this base. 2) The use of US germplasm to enhance the overall productivity of South African germplasm. The lack of specific agronomic and combining ability information poses the biggest initial challenge in using exotic germplasm. With the globalization of the international seed trade, access to elite exotic inbreds, rather than relatively unimproved sources, makes the results of this study unique and applicable.

The main objective of this study was to rationalize the heterotic patterns prevalent in Southern African germplasm. This was accomplished by conducting two studies in tandem. The first was evaluating a ten parent diallel cross between six elite sub-tropical inbreds from South Africa (5) and Zimbabwe (1) and four elite temperate inbreds from Argentina (1) and the US (3). The diallel was evaluated over 25 environments in six countries (South Africa, Zimbabwe, Argentina, Brazil, Mexico and the US). In the second study, nine South African public inbreds were evaluated over 11 US environments, in testcrosses with two testers representative of the heterotic groups Reid Yellow Dent (RYD) and Lancaster Sure Crop (LAN). The second objective, was evaluating the diallel and testcross entries for resistance to Gray Leaf Spot (GLS), a foliar disease caused by the fungal pathogen Cercospora zeae-maydis (Tehon and Daniels, 1925). The final objective was to assess the possibility of using Simple Sequence Repeats (SSR) and genetic similarities among the testcross entries to assign the inbreds to either the RYD or LAN heterotic groups.

Inclusion of relevant checks does give all interested parties an opportunity to place the relative performance of the genotypes into their own perspective. From a US
perspective we can conclude the following: 1) Rather than trying to find an alternative to the RYDxLAN heterotic combination, an introgression approach is advocated. 2) RYD (in one form or another) remains the female and tester of choice. 3) From this study A272, E2558W, NPP, SWZ and POS (except for white maize) have no immediate value. 4) Given the importance of ITY (I137TN), M37W and FTY (F2834T) in South Africa, their relative mediocre performance in the topcross study most probably is indicative of slow dry-down and barrenness when grown under US study conditions. Breeding crosses of them with either Iodent (IDT) or LAN and tandem selection for yield, dry-down and GLS resistance has a high probability of success. 5) D940Y should be considered as a source for GLS resistance and an alternative to M37W.

From a South African perspective, the following conclusions can be drawn: 1) Immediate gains are possible with using Corn Belt germplasm. 2) Maintain ITY (I137TN), M37W and FTY (F2834T) as separate heterotic groupings to be used on the female side. RYD and LAN, which have poor per se adaptation to South Africa, could be used on the male side of the pedigree. 3) IDT has potential (yield, standability and early maturity) for use in breeding crosses with South African genotypes. 4) To make the maximum use of the US germplasm component, yield, disease resistance and grain quality should be emphasized on the female side of the pedigree.

There are alleles for GLS resistance present in the South African germplasm not found in Corn Belt germplasm. In this study the results were confounded with maturity, and this could have biased our perception of relative resistance towards the later-maturing genotypes. A suggested breeding strategy would be using the South African genotypes in breeding crosses with LAN and testcross with RYD.

The results from the SSR study does show promise for the preliminary assignment of unknown genotypes to predetermined heterotic groups. While we were able to get a unique fingerprint with five SSR markers, assigning the genotypes without prior knowledge of their heterotic affinity, breeding history or pedigrees is not advocated. Using 70 SSR markers, we were able to make more assignments that are accurate to either the RYD or LAN heterotic groups.