

Research Application Summary

Inheritance of resistance to maize weevil *Sitophilus zeamais* (Motschulsky) in maize inbred lines and determination of their heterotic groups

Gafishi, M.K.¹, Tumutegyereize, J.K.¹ & Asea, G.²

¹Department of Crop Science, Faculty of Agriculture, Makerere University, P.O. Box 7062, Kampala, Uganda

²National Crops Resources Research Institute, P.O. Box 7084, Kampala, Uganda
Corresponding author: mkgafishi@yahoo.fr

Abstract

Maize weevil *Sitophilus zeamais* (Motschulsky) is a pest of maize causing serious losses to resource-poor farmers in the tropics. To combine resistance to Maize Weevil with high yield in maize, 52 inbred lines reported to harbor resistance were crossed to tester A and B and resultant progenies evaluated in different locations for yield. GENSTAT statistical package 12th edition revealed highly significant differences among entries for diseases and other important agronomic traits. Analysis of GCA and SCA showed that additive effects were more important than non additive for most of these traits. Additive and non additive effects had equal importance for response to yield in Namulonge, whereas SCA effects were more important in Masaka. Inbred lines were assigned to their heterotic groups. Across site analysis of GxE for yield revealed that the testcrosses were environment specific ($p < 0.01$). Weevil resistance study involved the inbred parents, ten top best crosses obtained from lines with tester A and B as well as their opposite crosses. Thirty-two young adult weevils were used to infest 50-g maize samples.

Key words: Heterotic group, inheritance, maize weevil

Résumé

Les charançons du maïs *Sitophilus zeamais* (Motschulsky) est un ravageur du maïs provoquant de graves pertes aux agriculteurs pauvres en ressources dans les régions tropicales. Pour combiner la résistance au charançon du maïs avec un haut rendement dans le maïs, 52 lignées déclarées à entretenir la résistance ont été croisés pour tester A et B et les progénitures résultantes évaluées dans des endroits différents pour le rendement. La 12^e édition du progiciel statistique GENSTAT a révélé des différences très significatives entre les entrées pour les maladies et d'autres caractères agronomiques importants. L'analyse de la GCA et SCA a montré que les effets additifs étaient plus importants que les effets non additifs pour la plupart de ces traits. Les effets additifs et non additifs avaient une importance égale pour la

réponse à produire à Namulonge, tandis que les effets de SCA étaient plus importants à Masaka. Les lignées ont été attribuées à leurs groupes hétérotiques. À travers le site, l'analyse de GxE pour le rendement a révélé que les croisements d'essai étaient environnementalement spécifiques ($p < 0,01$). L'étude de la résistance du charançon a impliqué les parents consanguins, parmi les dix meilleurs croisements obtenus à partir de lignées avec le testeur A et B ainsi que leurs croisements contraires. Trente-deux jeunes charançons adultes ont été utilisés pour infester des échantillons de maïs de 50g.

Mots clés: Groupe hétérotique, héritage, charançon du maïs

Background

Maize ranks first in terms of global production among cereals, ahead of wheat and rice. In developed countries, maize is changing from simply being a food crop to a high value economic crop. However, its production is constrained by a number of biotic and abiotic stresses. Storage insects constitute one of the main post-harvest constraints affecting maize production. Maize weevil (*Sitophilus zeamais*) is a prominent maize pest throughout the tropics both in field and in storage. The use of host plant resistance could help to significantly suppress weevil populations to below grain damaging levels.

The study aims at combining good resistance to maize weevil with high yield in maize for sustained maize production in Uganda. Fifty-two maize inbred lines reported to harbor weevil resistance were crossed to 2 testers. Establishing inheritance of insect resistance and determination of inbred heterotic groups will ease the choice of inbred lines suitable for superior hybrid development with good resistance to maize weevil in Uganda.

Literature Summary

Although many modern maize possess improved agronomic performance and tolerance to abiotic and biotic stresses, traits that contribute to improved grain storage have been largely ignored (Bergvinson, 2000). However, assessment of intrinsic levels of resistance to maize weevil has shown large variation among maize genotypes. Susceptible genotypes are reported to attract the weevil for feeding, colonization and oviposition. Thus the emergence rate of new weevil progenies is referred to as one of the mostly used susceptibility parameters (Derera *et al.*, 2010). In Uganda, World Food Program (WFP) tolerates a maximum of 3% insect damage from a maize grain supplier. Diverse studies have confirmed quantitative inheritance, importance of maternal effect, additive and non-additive gene

Study Description

action for weevil resistance (García-Lara *et al.*, 2003). The cost of insecticides, the danger of insect resistance building up, harm to non-targeted species and the potential risk to users make the alternative control measures such as host plant resistance extremely important (Gu *et al.*, 2008).

Fifty-two inbred lines (Males) were crossed to two single cross testers, A and B (Females) using a Line/Tester mating design (Kempthorne, 1957) at National Crops Resources Research Institute (NaCRRI) Namulonge (1150m above sea level) during 2009 A growing season. The lines were replanted and selfed during 2009B to increase seed. Testcrosses were laid out in an alpha lattice design and replicated twice in Namulonge (Central), Ngetta (North) and Masaka (South-West Uganda) during 2009 B season. for evaluation. Days to flowering, reaction to diseases, plant and ear heights, husk cover and grain texture were recorded. GENSTAT statistical package 12th edition was used for data analysis. Ten top best crosses obtained from the inbred lines with tester A and ten best from the inbred lines with tester B as well as their opposite crosses were selected for weevil resistance inheritance study together with inbred parents. Screening for weevil resistance involved thirty-two 7-day-old insects that were used to infest 50 g samples of untreated sound maize grain. The number of F₁ weevil progenies, the grain weight loss and the Dobie's susceptibility index are used as resistance parameters.

Research Application

Results from single environment field evaluations have revealed that entries had a significant effect on yield disease occurrence and other important agronomic traits in both Masaka and Namulonge. Analysis of General Combining Ability (GCA) and Specific Combining Ability (SCA) showed that additive was more important than non additive effects for most of these traits. Additive and non additive effects had equal importance for response to yield in Namulonge, whereas SCA was more

Table 1. Across location yield means of 5 best testcrosses, season 2009 B.

No.	Genotype	Yield mean (t/ha)
1	TA/WL429-28	10.01 a
2	TA/WL429-40	9.37 ab
3	TA/WL429-39	8.84 abc
4	TA/WL429-12	8.84 abc
5	TA/WL429-35	8.73 a-d
Check	Long 10 H	8.39 b-h

important than GCA effect in Masaka. The inbred lines were assigned to heterotic groups. Across site analysis of GxE for yield revealed that performance of testcrosses was environment specific ($p < 0.01$). Means were separated using the Least Significant Difference (LSD) test at 5% level of significance. A number of testcrosses outyielded the best local hybrid check Longe 10 H.

Recommendation

Another evaluation will be necessary to confirm the performance of the best genotypes.

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