Combining ability and identification of novel sources of fall armyworm resistance in tropical mid-altitude maize

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- Wilber Wambi ORCID: orcid.org/0000-0002-5788-4527[1,4],
- Dan Makumbi ORCID: orcid.org/0000-0002-1801-5986[2],
- Godfrey Asea ORCID: orcid.org/0000-0003-1441-2199[3],
- Habtamu Zeleke[4],
- Anani Y. Bruce ORCID: orcid.org/0000-0002-0413-5557[2],
- Mulatu Wakgari[4] &
- Boddupalli M. Prasanna ORCID: orcid.org/0000-0002-5761-2273[2]

Show authors

Abstract

Fall armyworm (FAW; *Spodoptera frugiperda*), is a major constraint to maize production in sub-Saharan Africa, creating an urgent need to identify adapted sources of resistance to develop host-plant resistant hybrids. Using a 17-parent half-diallel of diverse tropical maize germplasm (10 elite CIMMYT lines and seven new lines), this study estimated general combining ability (GCA) and heterosis for FAW resistance and key agronomic traits. Experimental hybrids and their parental lines were screened under artificial FAW infestation across three seasons in 2020 and 2021 at Kiboko in Kenya. Data were recorded for FAW damage resistance traits, including leaf damage at 7 (LD1), 14 (LD2), and 21 (LD3) days after infestation, ear damage (ED), ear rot, and grain yield. Both additive and non-additive genetic effects were highly significant for leaf damage at all intervals and grain yield. Two new lines CKL187019 and CKL187011, and CKSBL10153 combined desirable GCA effects for FAW leaf

and ear damage traits, with CKL187011 and CKSBL10153 also showing desirable GCA effects for grain yield. For grain yield, lines CKL187008, CKL187011, CKSBL10153, CML372 and CML402 showed significant positive GCA effects. Recurrent selection as a breeding strategy to increase the frequency of favorable alleles is essential for improving FAW resistance while enhancing grain yield. Desirable (negative) mid-parent heterosis for LD3 and ED was observed in 57% and 81% of the crosses, respectively, while 97% of the crosses expressed positive heterosis for grain yield (13.1% to 436.7%). Overall, these results highlight the potential of newly identified donor lines and hybrids for the development of high yielding, FAW-resistant tropical maize.