Abstract

Maize, a genetically diverse crop, is the third largest cereal crop in the world and the most important staple cereal in sub-Saharan Africa, supplying 50% of the calorie intake in this region. The stemborer Chilo partellus (Swinhoe) (Lepidoptera: Crambidae) is a key constraint to cereal production in most resource-poor smallholder farming systems in sub-Saharan Africa causing crop losses accruing up to 88%. Previous studies have shown that feeding by herbivorous insects induces maize to emit volatiles attractive to natural enemies. However, these antagonists are recruited when damage has already been inflicted on the plant. Recent investigations revealed that egg deposition can induce maize landraces of Mesoamerican origin to emit volatiles attractive to C. partellus parasitoids, a trait previously reported to be absent in maize hybrids. However, genotypic variation in this indirect defence trait within maize varieties adapted to local agroclimatic conditions and the effect of processes such as domestication and breeding on this trait are not known. Moreover, it is not known whether maize varieties possessing this indirect defence trait can directly deter further herbivore colonization and constitutively suppress the herbivore‟s larval development or whether they can induce the same defence trait in neighbouring unattacked plants. This study sought to fill these knowledge gaps with the aim of exploiting these plant defence traits in the development of ecologically sound crop protection strategies. Experiments were conducted in which headspace volatile samples were collected from plants of wild, landrace and hybrid maize with and without C. partellus eggs. Chemical analyses were done using gas chromatography (GC), coupled GC-mass spectrometry (GC-MS) and coupled GC-Electroantenography (GC-EAG). Behavioural bioassays were done using egg (Trichogramma bournieri Pintureau (Hymenoptera: Trichogrammatidae)) and larval (Cotesia sesamiae Cameron (Hymenoptera: Braconidae)) parasitoids in a 4-arm olfactometer using volatiles collected from the plants. Moreover, C. partellus larval preference, growth and development as well as subsequent oviposition behaviour of gravid C. partellus moths on these plants were determined. Behavioural assays showed that both T. bournieri and C. sesamiae preferred volatiles from four of the five wild teosinte species, five landraces and one of two maize hybrids exposed to egg deposition. Similarly, volatiles collected from unoviposited maize landrace plants exposed to oviposited landrace maize plants emitting oviposition-induced volatiles, were attractive to both egg and larval parasitoids. Moreover, maize varieties emitting these oviposition-induced volatiles deterred further herbivore colonization and suppressed larval development. Volatile analysis by GC and GC-MS revealed marked increases in volatile emission as well as qualitative changes in the odour blends in four wild types, five landraces and one hybrid, following stemborer oviposition. Coupled GC-EAG analysis of attractive samples revealed that C. sesamiae was responsive to (E)-2- hexenal, (Z)-3-hexen-1-ol, nonane, 6-methyl-5-heptene-2-one, α-pinene, myrcene, limonene, (E)-4,8-dimethyl-1,3,7-nonatriene, decanal, 3,4-dimethylacetophenone and (E)-β-farnesene. Results from this study provide insights into tritrophic interactions thus paving the way for designing novel and ecologically sound pest management strategies through breeding crops with this novel oviposition-induced defence trait.