Old ways help modern maize to defend itself

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Many modern crops have high productivity, but have lost their ability to produce certain defence chemicals, making them vulnerable to attack by insects and pathogens. Swiss scientists are exploring ways to help protect 21st century maize by re-arming it with its ancestral chemical weapons.

The researchers, led by Dr Ted Turlings (University of Neuchâtel, Switzerland), found that many varieties of modern maize have lost their ability to produce a chemical called E-β-caryophyllene. This chemical is normally produced by traditional ancestors of modern maize roots when the plant is under attack from invading corn rootworms. The chemical attracts 'friendly' nematode worms from the surrounding soil which, in turn, kill the corn rootworm larvae within a few days.

The scientists used genetic transformation to investigate if restoring E-β-caryophyllene emission would protect maize plants against corn rootworms. After introducing a gene from oregano, the transformed maize plants released E- β-caryophyllene constantly. As a result, these plants attracted more nematodes and suffered less damage from an infestation of Western Corn Rootworms.

"Plant defences can be direct, such as the production of toxins, or indirect, using volatile substances that attract the natural enemies of the herbivores" says lead scientist, Dr Ted Turlings (University of Neuchâtel, Switzerland). One of the types of toxins that maize plants produce against their enemies is a class of chemicals called benzoxazinoids. These protect maize against a range of insects, bacteria and fungi pests, yet some species have developed resistance against these

toxins and may even exploit them to identify the most nutritious plant tissues.

These results show how knowledge of natural plant defences can be practically applied in agricultural systems. "We are studying the wild ancestor of maize (teosinte) to find out which other chemical defences may have been lost during domestication of maize" Dr Turlings added. "These lost defences might then be reintroduced into modern cultivars".

This work is to be presented at the Annual Meeting of the Society for Experimental Biology in Manchester on Friday 4th July.

More information: Further information about this work is available in the following publications:

Robert, C. A. M., N. Veyrat, et al. (2012). "A specialist root herbivore exploits defensive metabolites to locate nutritious tissues." *Ecology Letters*, Volume 15, Issue 1, Pages 55-64.

Degenhardt, J., I. Hiltpold, T.G. Köllner, M. Frey, A. Gierl, J. Gershenzon, B.E. Hibbard, M. R. Ellersieck, T.C.J. Turlings, (2009). "Restoring a maize root signal that attracts insect killing nematodes to control a major pest". *Proc. Natl. Acad. Science USA* Volume 106, Pages 13213-13218.

Rasmann, S., T. G. Köllner, J. Degenhardt, I. Hiltpold, S. Töpfer, U. Kuhlmann, J. Gershenzon, and T. C. J. Turlings (2005). "Recruitment of entomopathogenic nematodes by insect damaged maize roots". *Nature*, Volume 434, Pages 732-737.

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