Drought tolerance in crops: Shutting down the plant's growth inhibition under mild stress

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VIB/UGent researchers have unveiled a mechanism that can be used to develop crop varieties resistant to mild droughts. For years, improving drought tolerance has been a major aim of academic and industrial research, thereby focusing on effects of extreme drought stress. However, translating this research to the field has proven to be problematic. In a set of papers in *Nature Biotechnology* and the *Plant Cell*, the team of Dirk Inzé at the VIB Department of Plant Systems Biology, UGent now shows that the focus should be on mild drought stress instead. It turns out that under non-lethal stress conditions plants inhibit growth more than absolutely necessary, opening new opportunities for yield improvement.

"By applying this knowledge to the selection of new crop varieties, unnecessary yield losses through drought stress can be avoided, resulting in higher productivity," Dirk Inzé from VIB-UGent said.

Only recently the World Bank warned that the world is facing a devastating food price crisis, with yield losses due to weather events being named one of the components of this complex problem. Producing more food on limited arable land, considering the increasing scarcity of water and unpredictability of the weather due to global warming, will be one of the major challenges for this century. One way to increase crop productivity is targeting drought stress, which is currently the main factor decreasing actual yields. Research in this area however so far

largely failed to result in crops that perform better in drought conditions.

Much of this research has focused on improved plant survival under very severe drought. However, as shown by Aleksandra Skirycz and Korneel Vandenbroucke, plants that are more likely to survive these extreme conditions do not grow better under more mild drought conditions. This is important as in the field drought rarely is severe enough to kill plants, but rather affects their growth. The paper, published in Nature Biotechnology, also shows that plants actively choose to grow slower when water gets limiting, although they have enough resources to keep growing.

In a follow-up study early leaf growth, entirely driven by cell division, was chosen as a model to unravel the mechanisms underlying this active growth inhibition. Aleksandra Skirycz and Hannes Claeys showed that the plant hormone ethylene shuts down leaf growth very fast after the plant senses limited water availability. If the stress is only temporary, growth can resume nonetheless. This research opens up new approaches to develop crop varieties that keep on growing during mild and temporary spells of drought that occur in the field, avoiding unnecessary yield losses and thus resulting in higher crop productivity.

More information: Survival and growth of Arabidopsis plants given limited water are not equal, Aleksandra Skirycz, Korneel Vandenbroucke, et al, *Nature Biotechnology*, doi:10.1038/nbt.1800

Pause-and-stop – the effects of osmotic stress on cell proliferation during early leaf development in Arabidopsis and a role for ethylene signaling, Aleksandra Skirycz, Hannes Claeys, et al, *Plant Cell*, in press

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