Climate changes require better adaptation to drought

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Maize is a crop that will find things more and more difficult as climate change gives us more drought during the summer. Here is a Danish maize field from July 2018. Credit: Janne Hansen

Europe's future climate will be characterised by more frequent heat waves and more widespread drought. Heat and drought will both challenge crop production, but drought in particular will be a problem—especially for spring sown crops such as maize.

After the summer of 2018, scientists have a sense of how the future summer climate of Europe might be: lots of heat and serious drought—and crops that wither and die. The risk of experiencing summers like the one just past will increase in the years to come due to climate change. Therefore, future agriculture requires crops and cultivation methods better suited to the new conditions.

This will require knowledge about the drivers of crop yield under climate change. A European team of scientists, which included researchers from the Department of Agroecology, Aarhus University, have addressed this issue, and have recently published the results of their studies in *Nature Communications*.

The research team, which was led by Leibniz Centre for Agricultural Landscape Research, investigated whether heat or drought poses the greatest threat to maize and winter wheat in Europe. The researchers based the analysis on insights of plant physiology to show—for the first time ever on a large scale—what exactly causes yield losses at elevated temperatures.

Heat and drought should be managed in each their way

It might seem irrelevant to separate heat from drought, because in Europe, the fields normally become very dry when there has been a prolonged hot period. It is, however, important to differentiate. The defence mechanisms of plants against drought are different from those

used to protect against heat stress. The researchers found that wheat and maize under climate change will be most affected by drought and less so by heat stress.

"By understanding whether heat or drought poses the greatest risk to the individual types of crops, farmers and plant breeders can more readily develop and select the crop varieties and management systems that are most suitable," says one of the authors of the article, Professor Jørgen E. Olesen from the Department of Agroecology, Aarhus University.

The researchers used an ensemble of 10 models to calculate how much heat or drought, respectively, contributes to yield losses in winter wheat and maize. To verify if the models gave a correct picture, the researchers compared the model results with yield data from 1984 to 2009. This enabled them to quantify how much the individual climatic factors contributed to the variations in yields during this 25-year period. Thereafter, the researchers used the models to predict wheat and maize yields up to 2050.

Maize in particular will be under pressure

If agriculture continues to use the current varieties and current cropping systems, climate change on a whole will lead to yield losses in maize and increasing yields in wheat. Heat stress will, on average for all of Europe, not pose a problem for crops if there is sufficient rainfall, while drought stress will pose a problem for maize, in particular. In years with low yields, drought will be a problem for both maize and wheat, and there will be no benefit from increased levels of CO_2, which would otherwise benefit yields in the absence of drought.

"Our results show that in Europe drought will be a bigger problem than heat, and that drought is a bigger problem for maize than wheat. This means that it will be less attractive than expected for Danish farmers to

switch from wheat to maize as the climate warms up," says Olesen.

Knowing that drought, in particular, will be the problem, farmers and plant breeders can more readily take measures with regard to developing new crop varieties, and choosing crop types, cropping systems and irrigation systems.

More information: Heidi Webber et al, Diverging importance of drought stress for maize and winter wheat in Europe, *Nature Communications* (2018). DOI: 10.1038/s41467-018-06525-2

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