New evidence that global warming will hurt US wheat production

May 12 2015, by Bob Yirka

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(Phys.org)—A trio of researchers, one each from Mississippi State

University, Kansas State University and the University of Arkansas has found evidence that suggests global warming will cause a reduction in U.S. wheat production in the years ahead. In their study published in *Proceedings of the National Academy of Sciences,* Jesse Tack, Andrew Barkley and Lawton Lanier Nalley describe how they studied winter wheat production for an area in Kansas and compared it against weather data and what they found by doing so.

As the planet continues on its apparently inevitable march to a warmer future, scientists the world over are scrambling to understand what impact it will have—from rising ocean levels to crop production. In this latest effort, the researchers sought to find out what might happen to wheat yields in the United States as temperatures rise. To say that wheat is an important crop is an understatement, it accounts for 20 percent of total daily calories consumed by humans across the globe, and represents a far higher ratio for many people in third world countries. Scientists have been working hard for many years to increase the amount of wheat grain that a farmer can get from a given field—currently such yields are still seeing increases of approximately 1 percent each year, which is remarkable. But that may change soon, this newest research suggests.

For over thirty years, winter wheat trials have been taking place in Kansas, home to one of the largest producers of wheat—$2.8 billion worth in 2013 alone. That trial has yielded a lot of data, some of which the research team found indicated that modern strains are vulnerable to both extremely high and low temperatures. The low temperatures are not much of a concern in this study of course, but the high temperatures appeared to cause significant yield reductions—they even found a cutoff point—34 degrees Celsius. Overall they found a 15 percent reduction in yields when temperatures rose on average just 2 degrees Celsius and a 40 percent decline when average temperatures went up just 4 degrees. Sadly, they also found that more modern plants were more vulnerable than older strains.

What this means, the researchers suggest, is that places that currently grow wheat are likely to suffer as global warming progresses. Currently, it is not clear if land lying north, where it will presumably be colder, will be able to support the level of predicted yield needs for the future.

More information: Effect of warming temperatures on US wheat yields, Jesse Tack, DOI: 10.1073/pnas.1415181112

Abstract

Climate change is expected to increase future temperatures, potentially resulting in reduced crop production in many key production regions. Research quantifying the complex relationship between weather variables and wheat yields is rapidly growing, and recent advances have used a variety of model specifications that differ in how temperature data are included in the statistical yield equation. A unique data set that combines Kansas wheat variety field trial outcomes for 1985–2013 with location-specific weather data is used to analyze the effect of weather on wheat yield using regression analysis. Our results indicate that the effect of temperature exposure varies across the September–May growing season. The largest drivers of yield loss are freezing temperatures in the Fall and extreme heat events in the Spring. We also find that the overall effect of warming on yields is negative, even after accounting for the benefits of reduced exposure to freezing temperatures. Our analysis indicates that there exists a tradeoff between average (mean) yield and ability to resist extreme heat across varieties. More-recently released varieties are less able to resist heat than older lines. Our results also indicate that warming effects would be partially offset by increased rainfall in the Spring. Finally, we find that the method used to construct measures of temperature exposure matters for both the predictive performance of the regression model and the forecasted warming impacts on yields.