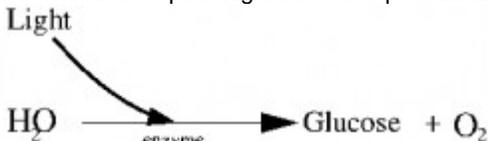


# One thing we have learnt this week- climate change and food security

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One thing we have learnt this week is we need to worry about food security due to climate change. The Intergovernmental Panel on Climate Change (IPCC) 5th assessment report covers a wide range of issues relating to climate change, but knowing readers of this blog are interested in food I have just decided to cover this one aspect. One of the arguments that climate sceptics have made is that increased carbon dioxide levels will increase plant growth. One right wing think tank in the US even produced a video claiming something along the lines "they called pollution we call it fertilizer". This belief which, to be fair, many climate scientists hoped might be true is presumably based on the overall

photosynthetic reaction shown below.  For any scientists reading

this yes I'm aware its not balanced, its just to keep it very simple. In crude chemistry terms if you increase the concentration one of the reactants on the left hand side then more product should be produced to bring the reaction back into a new state of chemical equilibrium. This is known as the law of mass action. The problem is that plant biochemistry is much more complicated than that indicated by the simple reaction above. For starters the reaction above is split up, water is broken down to hydrogen ions, electrons and oxygen in a plant organ known as the chloroplast and this process requires light. Carbon dioxide is captured to form sugars in light independent reactions (known as the Calvin cycle) by an enzyme called ribulose bisphosphate carboxylase oxygenase (RuBisCO. This protein is probably the most abundant enzyme on earth! Under dry conditions plants will attempt to save water by shutting pores called stomata. This means the carbon dioxide levels fall and the reaction above starts to go into reverse (so maintaining the chemical equilibrium). Various plants have adapted mechanisms to concentrate carbon dioxide and therefore maximise their growth. For example some tropical plants (such as maize) use a an additional chemical pathway called the C4 pathway to chemically "fix" the carbon dioxide making photosynthesis in these plants more effective. This last fact could be important to food security. Originally scientists thought plants would grow faster and bigger everywhere as CO2 levels rose. Measurements have not borne this out. Current thinking suggests that the plants in the tropics will suffer and plants in the northern hemisphere will do better. Could it be that in the tropics plants are as efficient as they can be due to pathways like C4? Whatever the reason plants in the tropics don't benefit from increased CO2. This is what the 5th assessment says; "*Based on these studies, there is medium confidence that climate trends have negatively affected wheat and maize production for many regions (Figure 7-2) (medium evidence, high agreement). Since many of these regional studies are for major producers, and a global study (Lobell et al. 2011) estimated negative impacts on these crops, there is also medium confidence for negative impacts on global aggregate production of wheat and maize. Effects on rice and soybean yields have been small in major production regions and globally (Figure 7-2) (medium evidence, high agreement). There is also high confidence that warming has benefitted crop production in some high-latitude regions, such as Northeast China or the United Kingdom Jaggard et al., 2007, Supit et al., 2010; Chen et al., 2010; Gregory and Marshall, 2012).*" If this was it then food security would be increased in temperate regions and decreased in the tropics. Which would be bad enough. The problem is this leaves out one huge elephant in the room - the weather. Different plants are adapted to different levels of sun and moisture (and humans are responsible for much of that adaptation). So for example rice likes growing in water, whereas maize will cope with much drier conditions. The 5th assessment does not reach definite conclusions on this weather related food security issue. In fact it states crop yields and weather are even more complicated and localised than the above might imply. "*The overall relationship between weather and yields is often crop and region specific, depending on differences in baseline climate, management and soil, and the duration and timing of crop exposure to various conditions. For example, rice yields in China have been found to be positively correlated with temperature in some regions and negatively correlated in others (Zhang et al., 2010). The trade-offs that occur in determining yield are therefore region-specific. This difference may be due to positive correlation between temperature and solar radiation in the former case, and negative correlation between temperature and water stress in the latter case. Similarly, although studies consistently show spikelet sterility in rice for daytime temperatures exceeding 33°C (Jadadish et al., 2007; Wassmann et al., 2009), some statistical studies find a positive effect of daytime warming on yields because these extremes are not reached frequently enough to affect yields (Welch et al., 2010). Responses to temperature may vary according whether yields are limited by low or high temperatures. However, there is evidence that high temperatures will limit future yields even in cool environments (Semenov et al., 2012; Teixeira et al., 2013).*" In other words on food security, the official view is we are guessing. Common sense has to come into play here though. As a keen non-professional gardener, since the late

90's I've seen the weather become increasingly erratic. I also know that almost everything I grow needs benign weather. Not too much rain or sun, just the right amount. The crazy weather we have been getting does not bode well in that regard. There are also other issues such as rising demand, population increase and peak oil that must be factored in. Food security looks like being an increasing challenge over the next couple of decades and going forward. We all have a responsibility to stop this happening, as the writer of proverbs says; "*A good man leaves an inheritance to his children's children, but the sinner's wealth is laid up for the righteous. The fallow ground of the poor would yield much food, but it is swept away through injustice.*" Proverbs 13v22-3 Neil This passage will form the basis of part of a new book we are working on and is a very crude first draft.

*Posted in: Climate Change, Food | | With 1 comments*

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