Investigating drought tolerance in virus infected plants

Research into agricultural productivity is of major importance in today's society, where an exponentially growing population demands an increase of 70% in global food production by the year 2050. Minimising crop loss due to drought is one approach to which global crop output can be maximised. Past studies have reported a consistent trend in plants infected with RNA viruses; infected plants showed a delay in drought symptom onset when water was withheld compared to mock inoculated plants. For 8 weeks in the summer of 2017, I worked in Dr Rose Murray's lab in the University of Bristol Life Sciences Building to further investigate this water retention phenomenon on tobacco (*Niocotiana tabacum)*, tomato (*Solanum lycopersicum*) and quinoa (*Chenopodium quinoa*) plants. I also investigated the effects of virus infection upon the photosynthetic activity of these plant species using PAM (pulse-amplitude modulated) fluorometry.

The aim of this study was to confirm and extend the past findings into virus impacts on drought resistance in susceptible host systems and to explore their effects, if any, in resistant host systems. Tobacco mosaic virus (TMV) was the chosen virus for this study, with the susceptible host species being *N. tabacum* and *S. lycopersicum* plants and the selected resistant host species subsisting of *C. quinoa* plants. Duplicate groups of plants were inoculated with either TMV or water (mock inoculated). Plants were then incubated for 1 week before water was withheld for half of the individuals in the mock and TMV groups. Relative leaf water content measurements were taken on mock inoculated and virus infected individuals after a week period of drought conditions. This measurement gives an indication of the drought resistance of a given species. In addition, we evaluated the effect of virus infection on photosynthetic rate, as the production of water is directly linked to this process, we predicted that photosynthetic rate would be altered in virus infected individuals. A pulse of light was fired at the leaf using PAM fluorometry and the intensity of light re emission was measured, giving a between 0 and 1, where 0 is no light emission, and 1 was total light re-emission. This reading is called Fv/Fm and is commonly used to indicate the efficiency of a plants' photosynthetic apparatus. 0.7 is considered the value of a healthy plant system.

After sampling 156 plants (52 from each species), water retention was found to be higher on average in tomato and tobacco plants when virus infected compared to healthy counterparts. Quinoa plants were found to have no difference in their drought resistance ability between virus infected and non-virus infected plants. As quinoa is a resistant host to TMV, the plant is able to isolate the virus to one region of necrosis, preventing it from spreading around the plant and potentially inducing any drought resistance effects. It was also found that Fv/Fm values were lower on average in virus infected specimens from tomato and tobacco plants compared to healthy plants.

This project has given me a fascinating insight into the world of plant pathology, as well as giving me the opportunity to pick up crucial laboratory skills which are applicable in this field and many other aspects of biology. This includes aseptic technique, plant inoculation, PAM fluorometry and general good scientific practise. I would like to thank the BSPP for awarding me the undergraduate vacation bursary and Dr Rose Murray for all her help, which allowed me to gain this invaluable experience.

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