The effect of honeydew on photosynthesis in cotton

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INTRODUCTION

Cotton aphids (Figure 1A) secrete sugary honeydew which may build-up on cotton leaves (Figures 1B, 3B). This could block leaf pores (stomata) thereby reducing the exchange of CO_2 and water vapour which may reduce leaf photosynthesis and yield. Dust adhering to honeydew (Figure 3C) could reduce light reaching the leaf surface, further reducing photosynthesis.

HONEYDEW EFFECTS ON PHOTOSYNTHESIS

Leaves contaminated with honeydew (Pre-treatment, Figure 2) were first measured to ensure all leaves were similar.

Honeydew was then washed off half of the leaves and photosynthesis was re-measured (Treatment, Figures 1C & 2). The 'clean' leaves showed an increase in photosynthesis and stomatal conductance relative to the 'still contaminated' leaves. This suggests that honeydew is blocking stomata, thereby reducing photosynthesis. Leaf temperature was not affected.

Finally, the honeydew was washed of the 'still contaminated' leaves (Post-treatment, Figure 2). These leaves also recovered, confirming the effect of the honeydew.

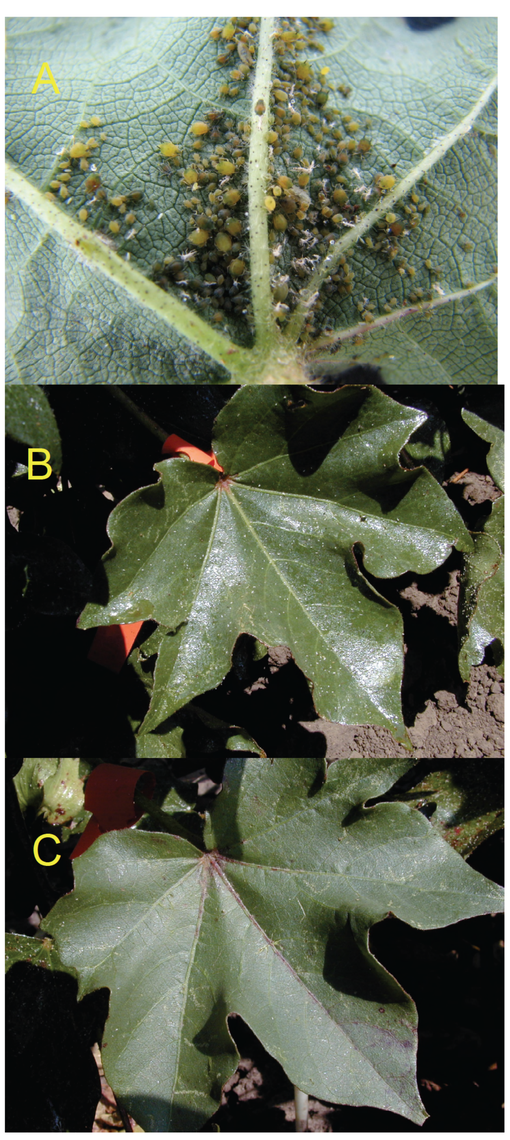

Figure 1: (A) Cotton aphids (B) cotton leaf covered in natural honeydew and (C) similar leaf after honeydew was washed off.

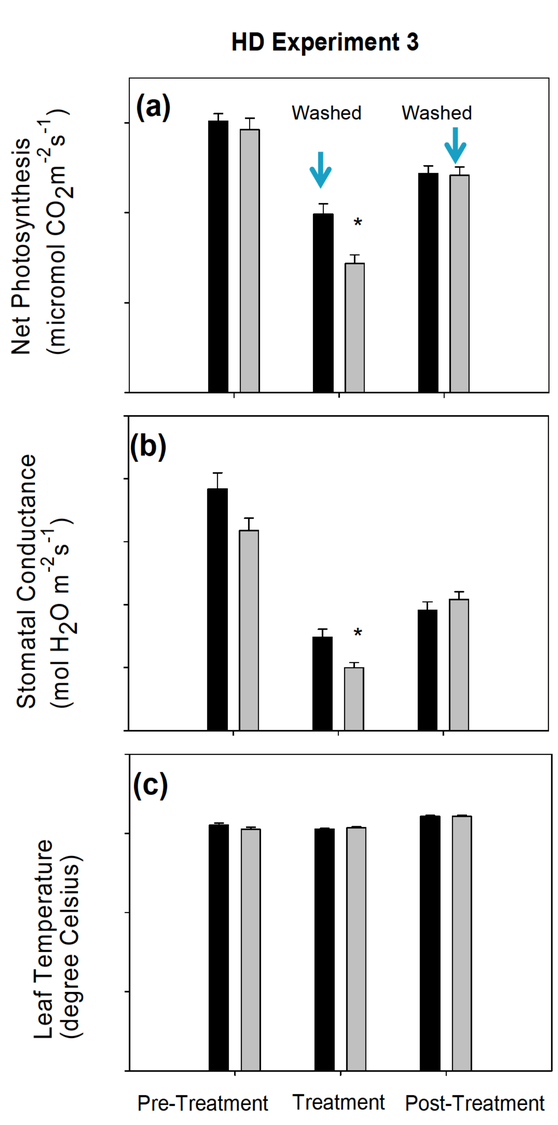

Figure 2: Mean (a) photosynthesis (b) stomatal conductance and (c) leaf temperature for natural honeydew. * symbols indicate a significant difference between treatments at P≤ 0.05.

EFFECTS OF DUST

Photosynthesis of clean leaves in the field was measured to ensure all leaves were similar (Pre-Treatment).

Four different treatments were applied:

- Control (no honeydew or dust) (Figure 3A)
- Dust only
- Artificial honeydew (Figure 3B)
- Artificial honeydew plus dust (Figure 3C)

Dust alone significantly reduced photosynthesis, honeydew alone reduced it more and the combination of the two reduced it even further. Stomatal conductance was reduced only by the combination of honeydew and dust while leaf temperature was unaffected by all treatments (Figure 4).

Leaves were then gently washed and remeasured 24 hours later. Washed leaves recovered to levels similar to the control leaves.

Figure 3: (A) Clean cotton leaf (B) with artificial honeydew and (C) with artificial honeydew plus dust.

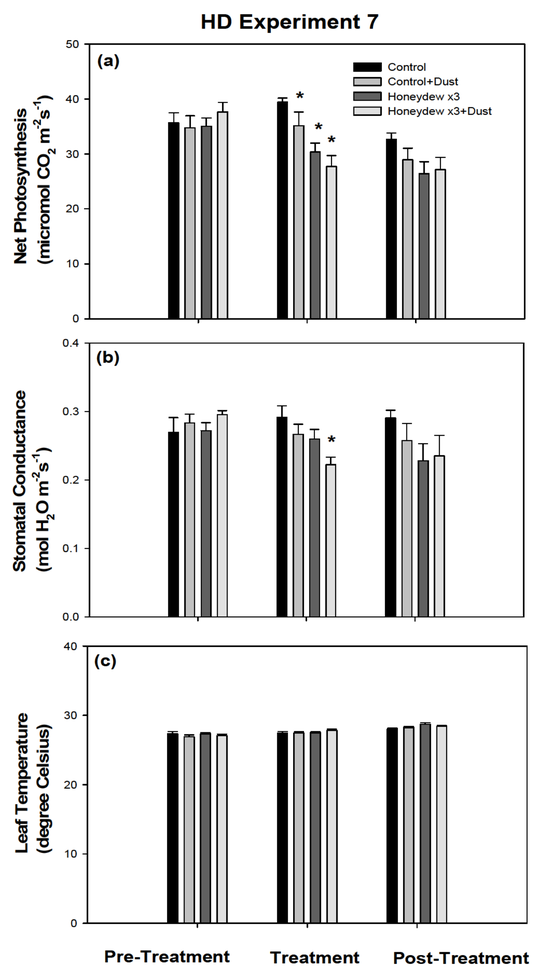

Figure 4: Mean (a) photosynthesis (b) stomatal conductance and (c) leaf temperature for clean leaves, leaves with dust, leaves with artificial honeydew and leaves with artificial honeydew plus dust. * indicates a significant difference from the control at P≤ 0.05.

CONCLUSIONS:

Honeydew reduced photosynthesis by blocking stomata and reducing gas exchange. However, leaves recovered quickly if honeydew was removed, so rainfall could benefit honeydew affected crops. Dust on the honeydew is a barrier to light reaching the leaf surface thereby exacerbating the effect of the honeydew.

FOR FURTHER INFORMATION

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