

Genomes to Fields 2014 Workshop

Unmanned Aerial Vehicles for High-Throughput Phenotype Analysis of Maize in the Field

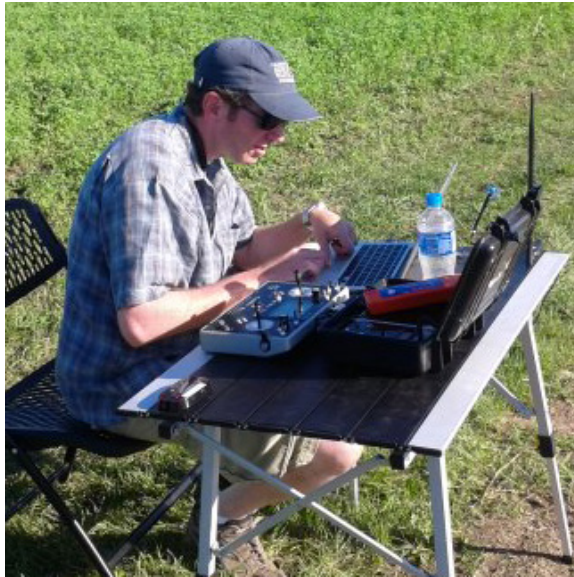
Edgar Spalding

Chicago, IL

December 10

the University of Wisconsin team

Michael Coen



Natalia de Leon



Shawn Kaeppler



Nathan Miller



Dustin Eilert



Michael Coen, Biostatistics and Medical Informatics

Natalia de Leon, Agronomy

Shawn Kaeppler, Agronomy

Nathan Miller, Botany

Dustin Eilert, Agronomy

Edgar Spalding, Botany



the machines



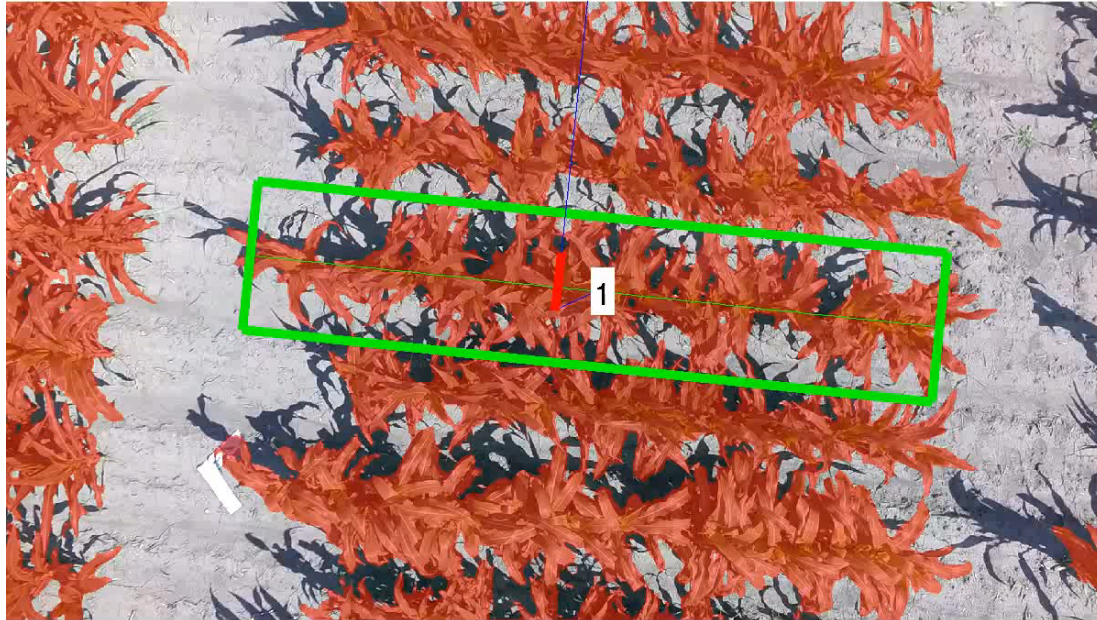
GOPRO



200 mm lens
on a DSLR



counting rows



[link](#)



creating a mosaic

(i) Image A (time=x)

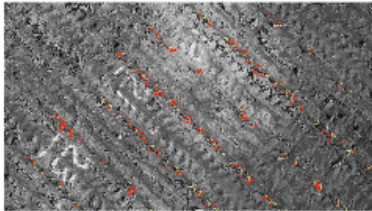
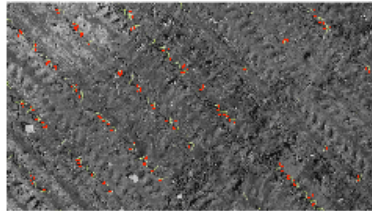
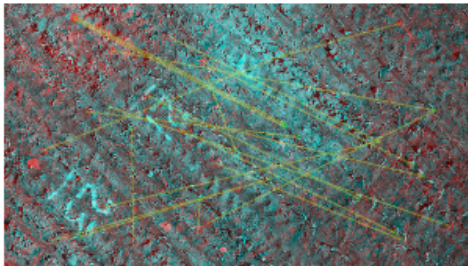


Image B (time=y)

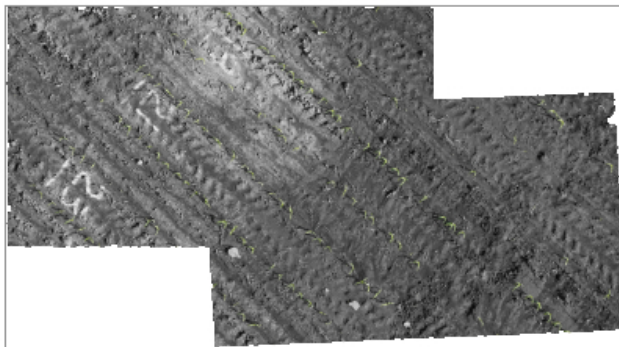


(ii)

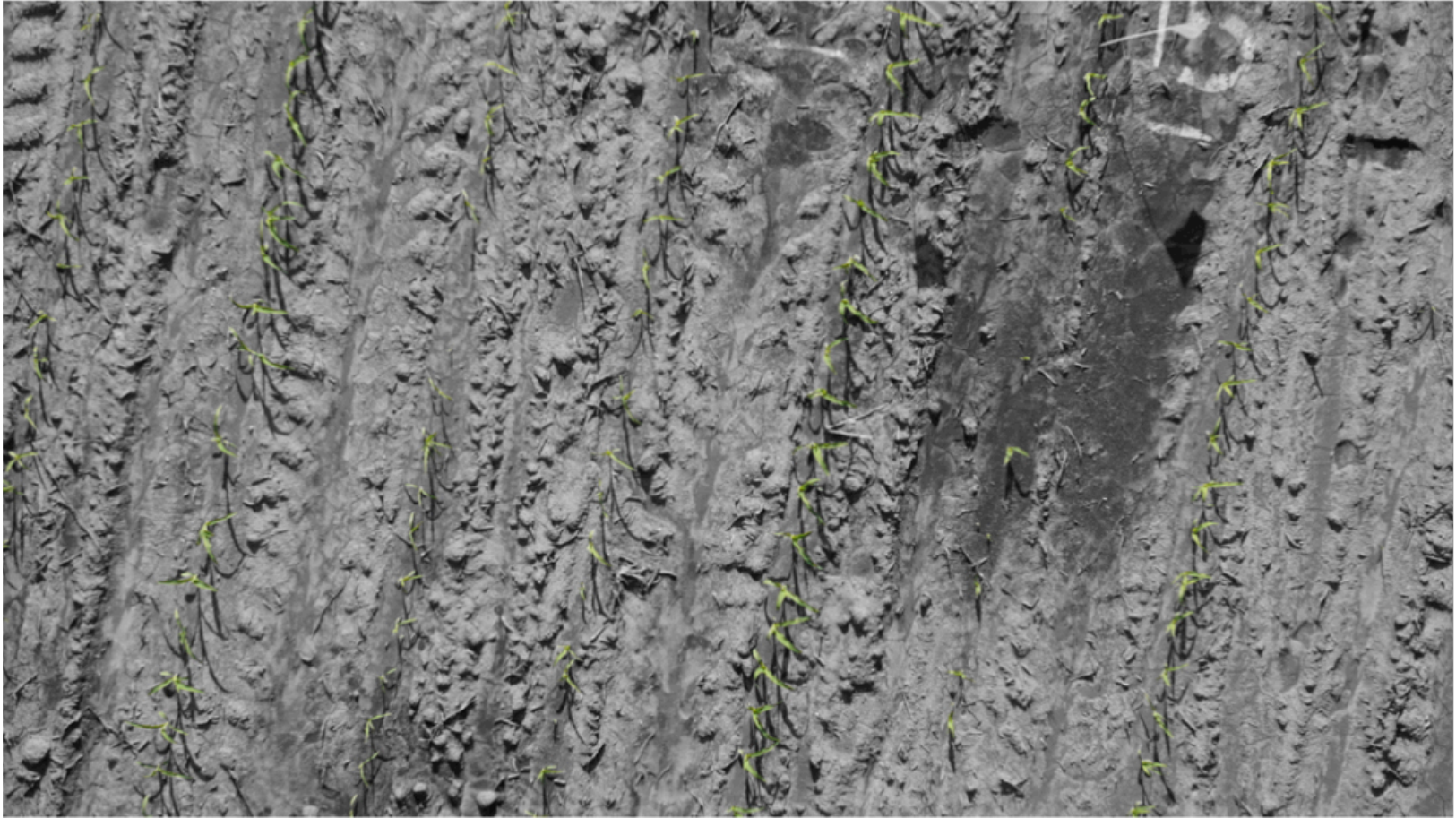


Compute an *affine* transformation to align matching regions. *Warp*s one image onto another.

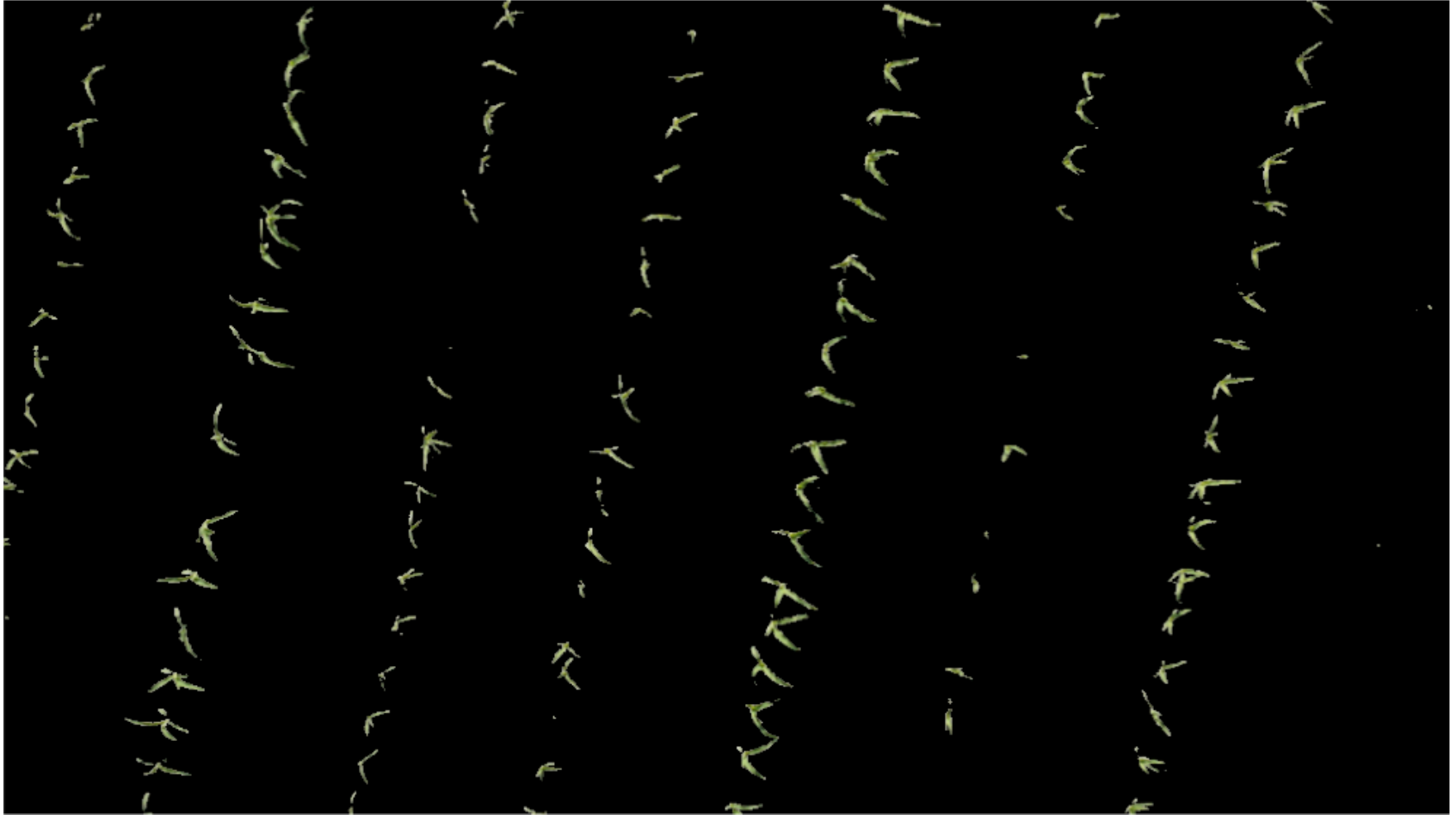
(iii)



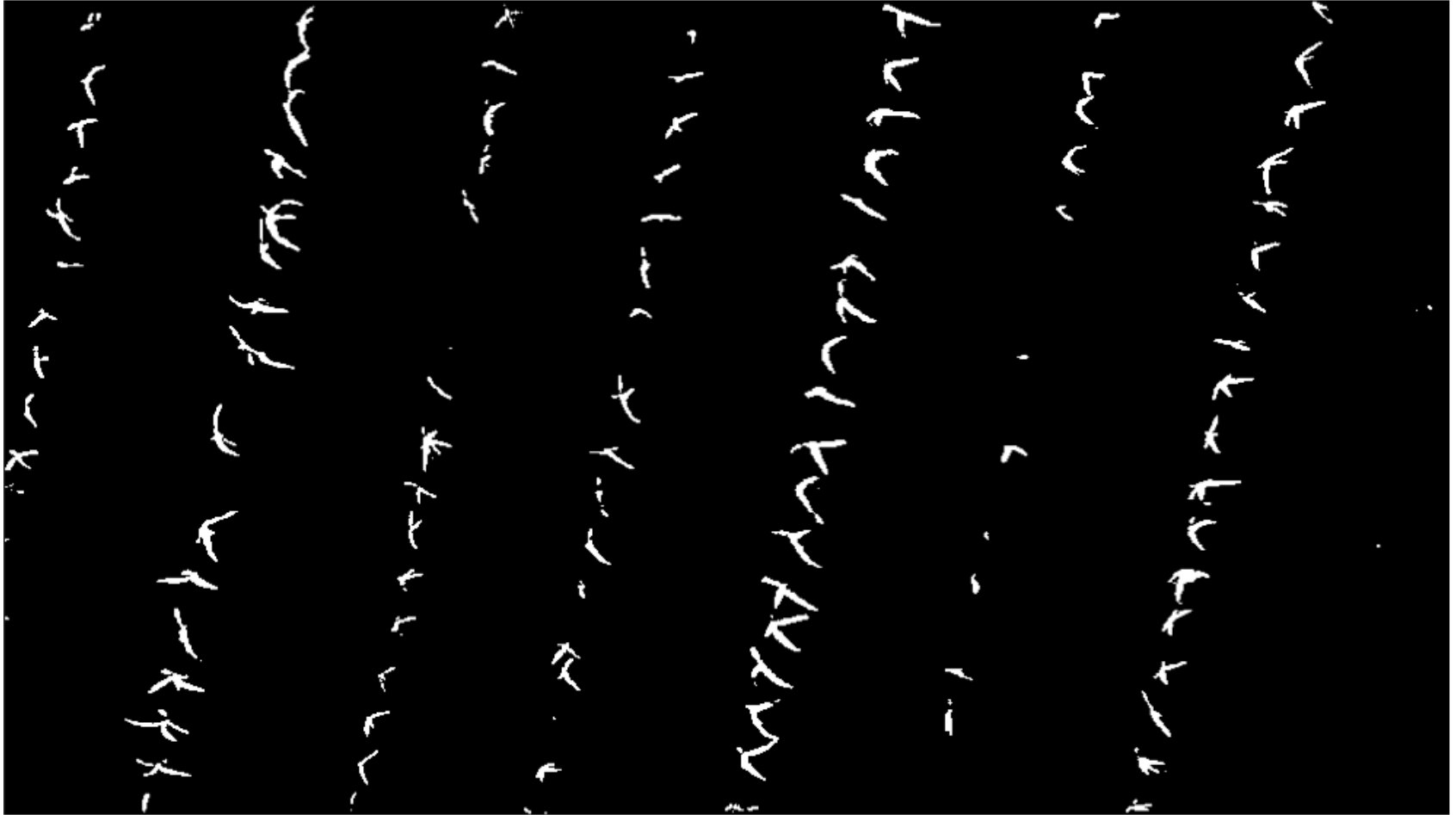
finding the seedlings



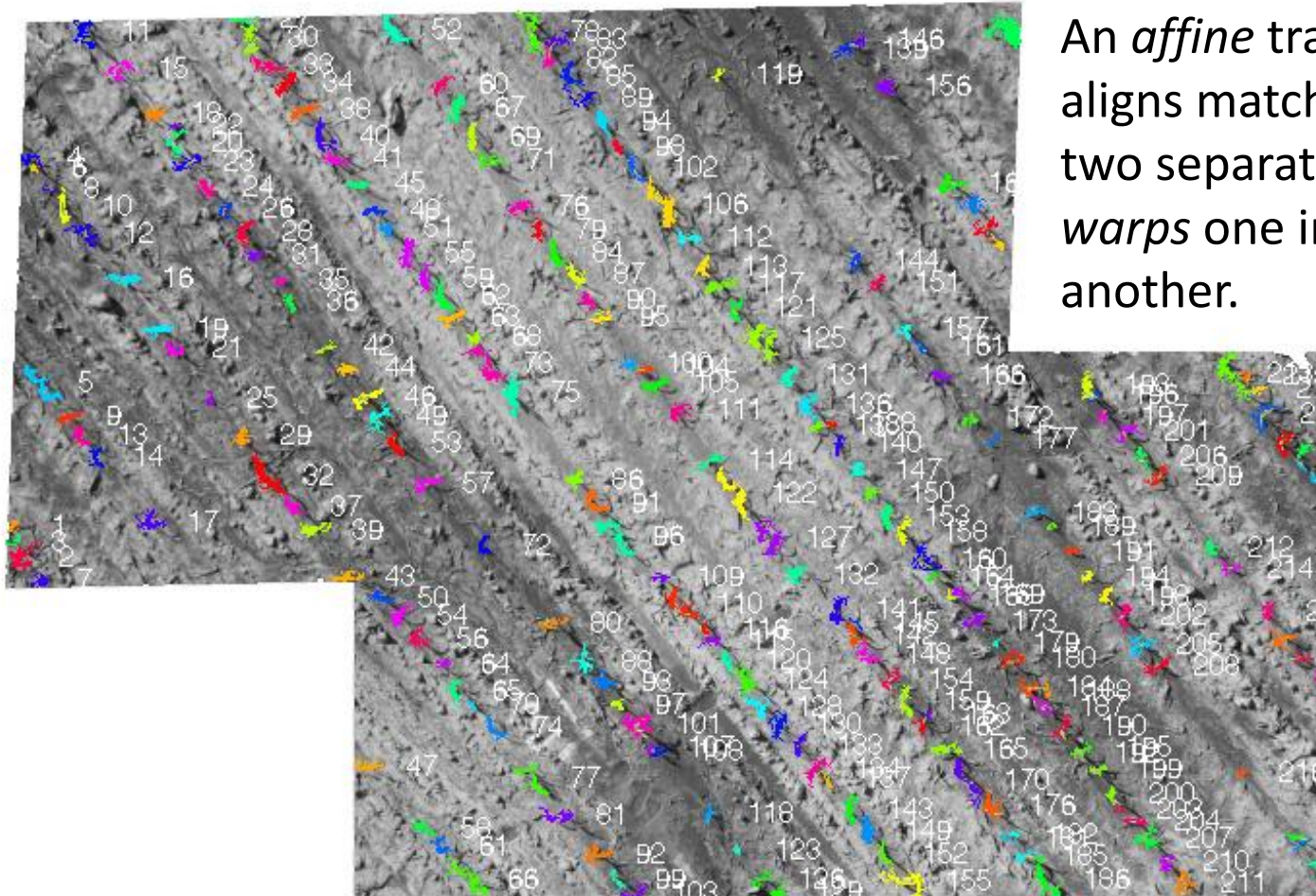
'segmenting' the seedlings



each is a morphological object



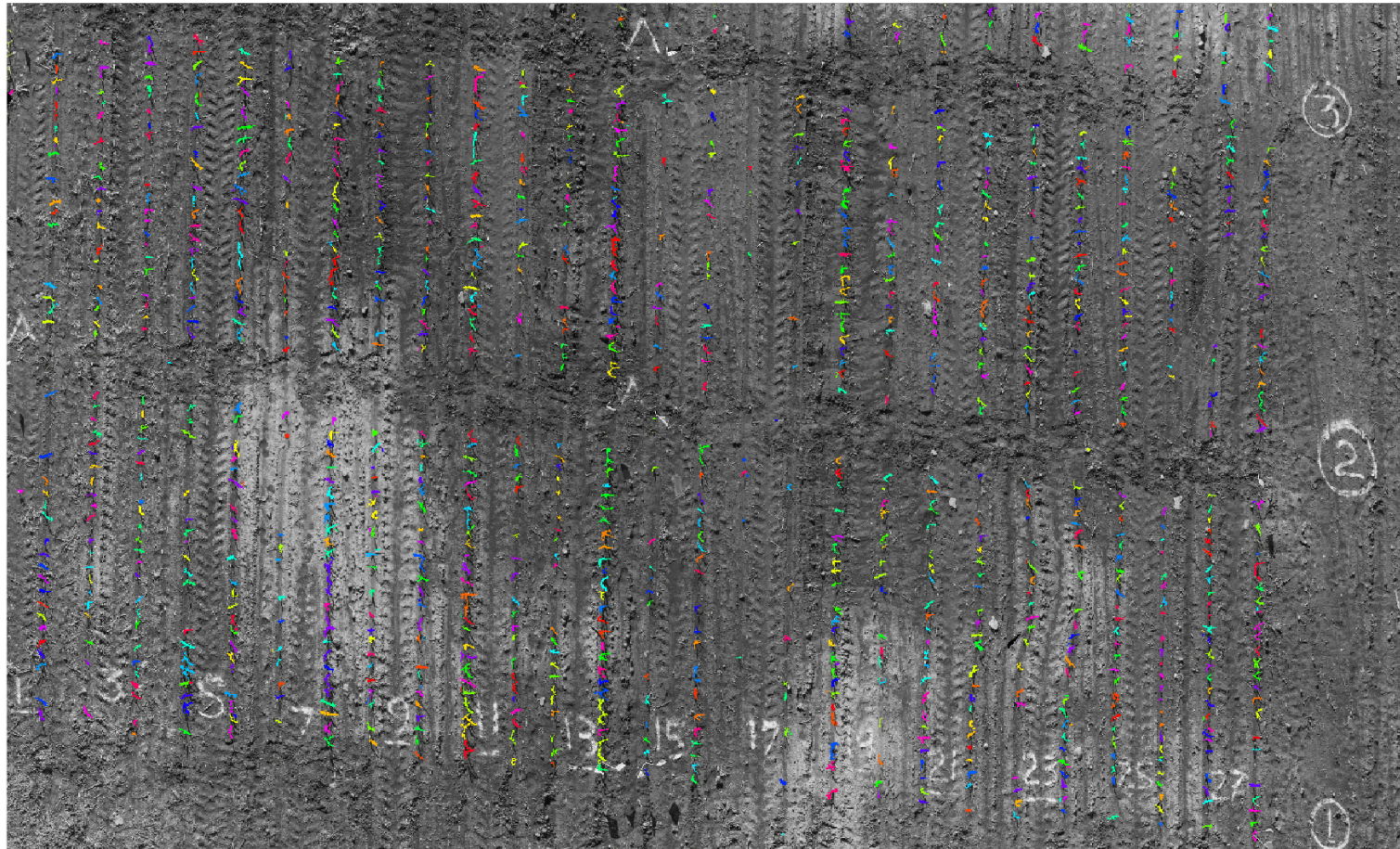
creating a mosaic



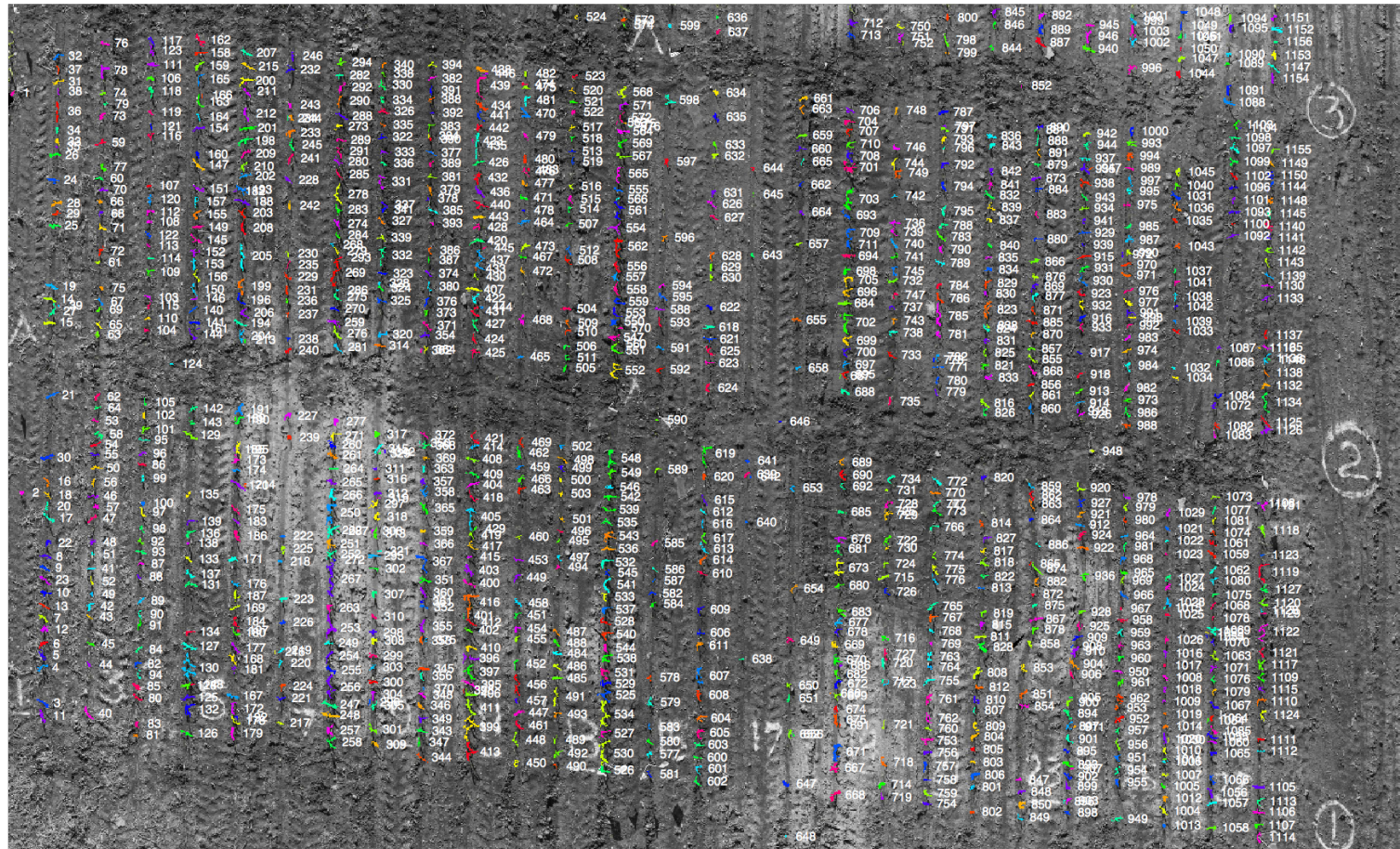
An *affine* transformation aligns matching regions in two separate images - *warps* one image onto another.



a field mosaic from ~4,800 pictures

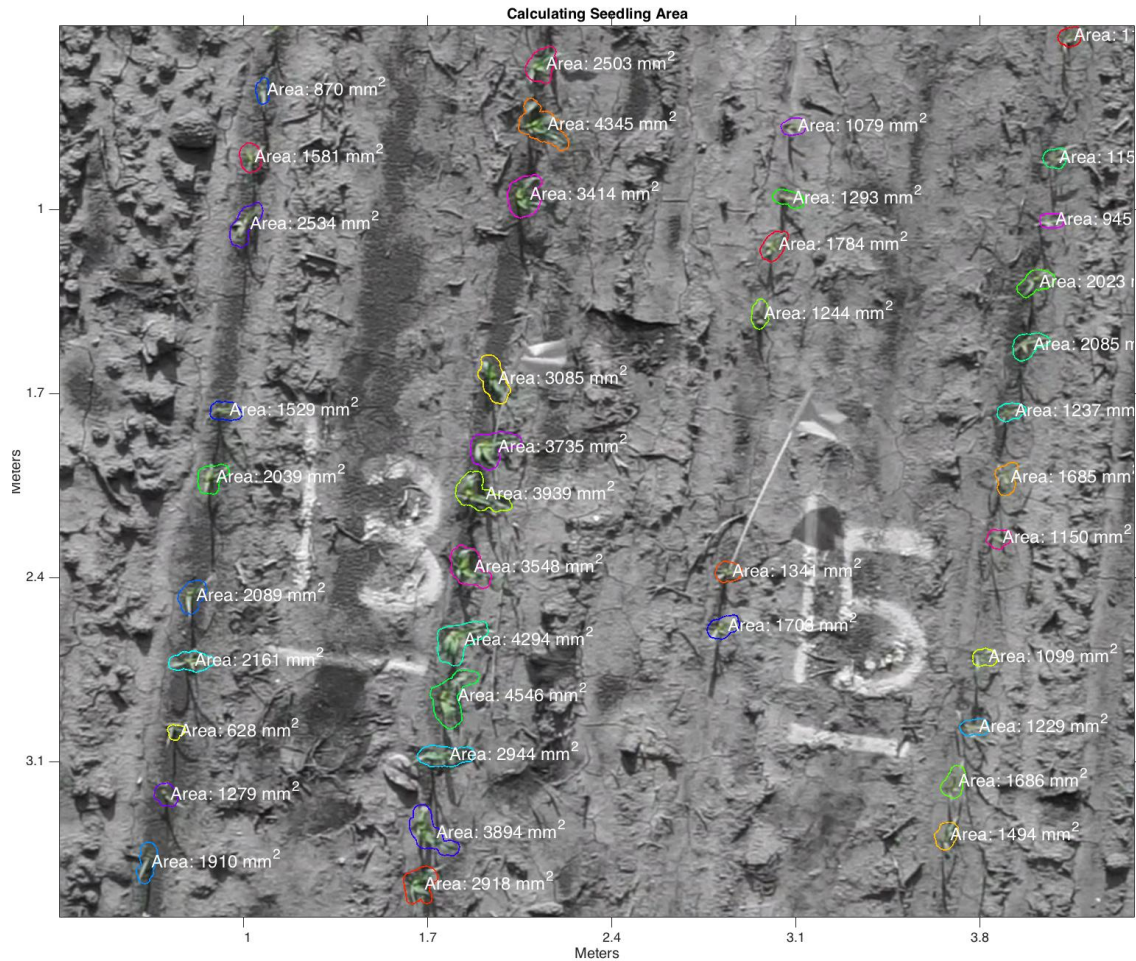


each object is tracked



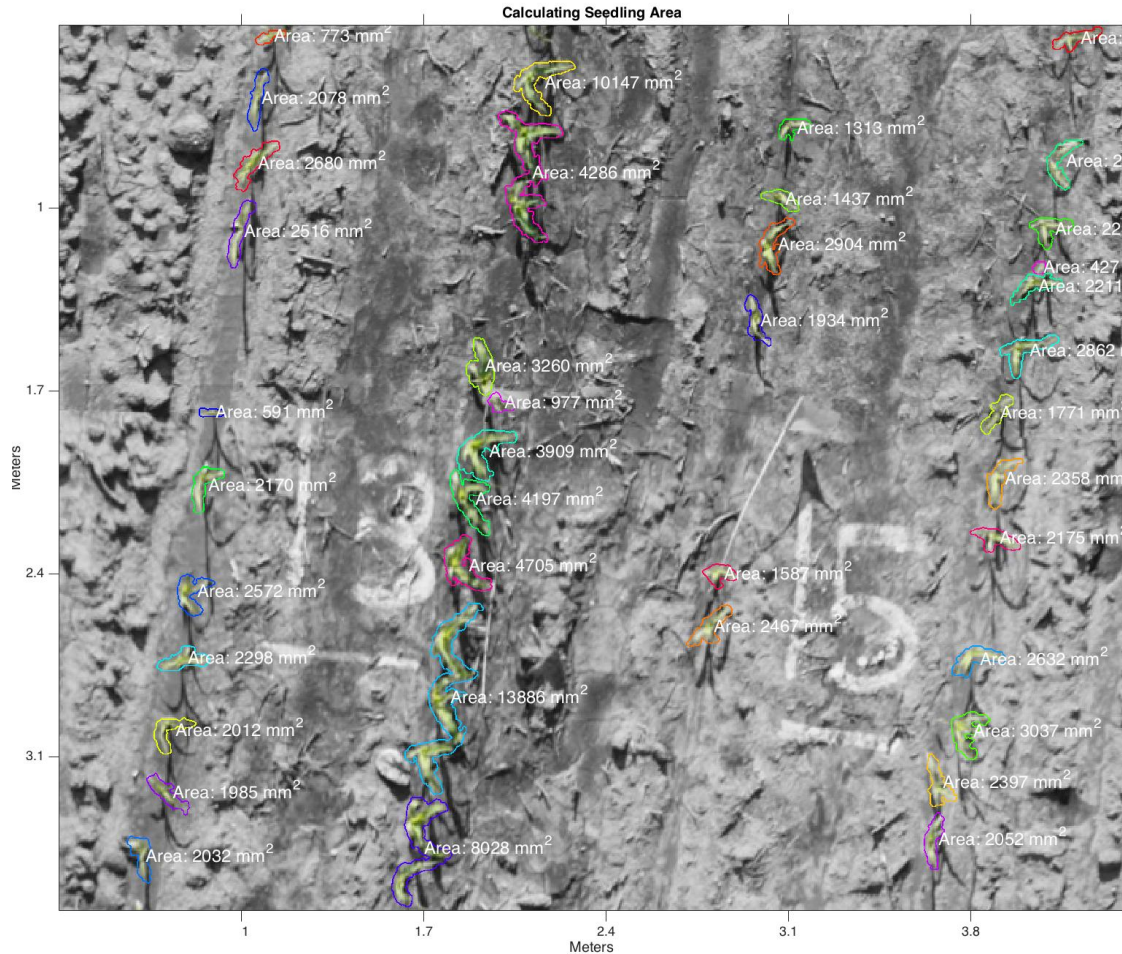
measuring growth

August 29, 2014



measuring growth

August 31, 2014



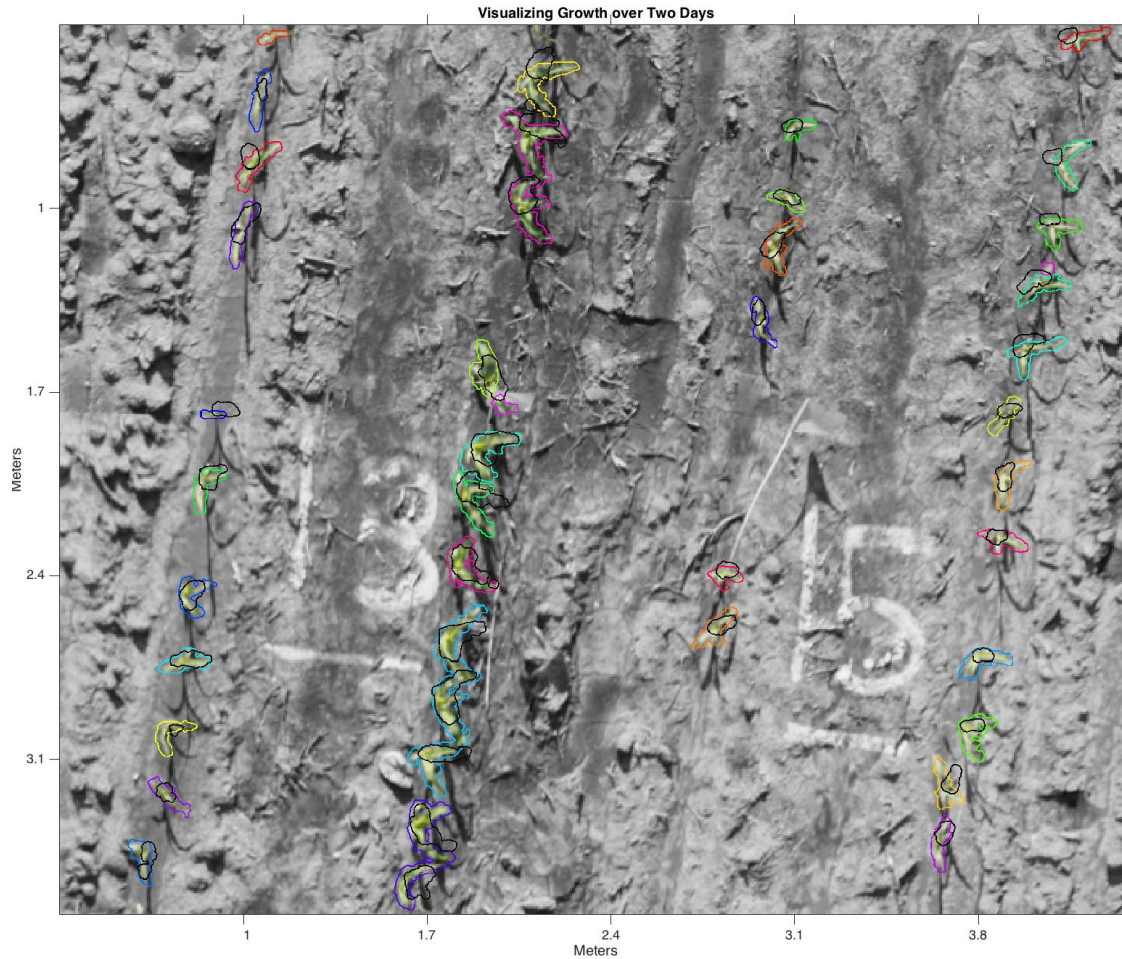
measuring growth

$$\Delta = +6616 \text{mm}^2$$

$$\Delta = +10330 \text{mm}^2$$

$$\Delta = +3190 \text{mm}^2$$

$$\Delta = +6048 \text{mm}^2$$



fixed cameras in the field



fixed cameras in the field



thinking ahead

- Much work remains at all technical stages to make UAV-based measurements routine
- Different biological stages will require different analytical methods and tools
- Data management and computation will be major technical challenges if UAVs are to be used across the Genomes to Field project

