

## **Proposed Project Summary:**

Create grid of  $0.25 \text{ m}^2$  cells in the various management treatments of the HSD plots. Create high resolution photo mosaic of *A. tuberculatus* seedlings at 1, 3 weeks after emergence. Use GIS (or image processing script in MATLAB) to obtain spatial coordinates for every seedling. Test for fractal dimension in seedling population structure at different developmental stages. Use Wallinga articles as starting point for analyses Wallinga [1995], Watkinson et al. [2000].

## **Summary of Research Methods**

**Resizing image** Squaring to grid in Photoshop (located in Start menu: Programs:Development Apps: Adobe Photoshop)

1. Open map file in Photoshop.
2. Save as Photoshop file
3. Select picture using marquis tool (rectangle with dotted border); Edit: Color Settings: sRGB color (should be default)
4. Select “View>Show:Grid”
5. Edit:Transform: Skew. Drag corners of selection box to fit to grid intersections, so quadrat is square
6. Click on cropping tool (you’ll be asked whether you want to accept the transform—say OK). Crop the image right up to the corner markers. Then click on arrow tool (you will be asked whether you want to crop the image—say OK)
7. Save as bitmap. Then resize using Image:Size; uncheck “Constrain proportions” and set image size at  $500 \times 500$  pixels.
8. Create Mosaic. Create a mosaic for each plot of  $1500 \times 1500$  pixels with all the images in their correct spatial positions.

### **Assigning addresses to seedling locations in MatLab**

1. Use **getpts** to pick points corresponding to the locations of the corn and weed seedlings.
2. Use plot these locations on top of the photo mosaic.
3. Export an image of only the weed seedling locations for post processing.

### **Post Processing**

1. Use **BoxCount** to estimate the fractal dimension for each plot.
2. Use **InequalityPackage** to estimate the Gini Coefficient for each plot for grid sizes 100 pixels, and 500 pixels.

### **Final Product:**

1. Photo Mosaic of Selected squares of crop at 1, 3 weeks.
2. Spatial coordinates for corn and weed seedlings for each square.
3. Fractal dimension of each plot, as well as the Gini Coefficient for grid sizes 100 pixels, and 500 pixels.

# Photo Mosaics



Figure 1: **Photo Mosaic For Plot 113 at One Week After Planting** The red circles represent weed seedling locations, and the yellow circles represent corn seedling locations

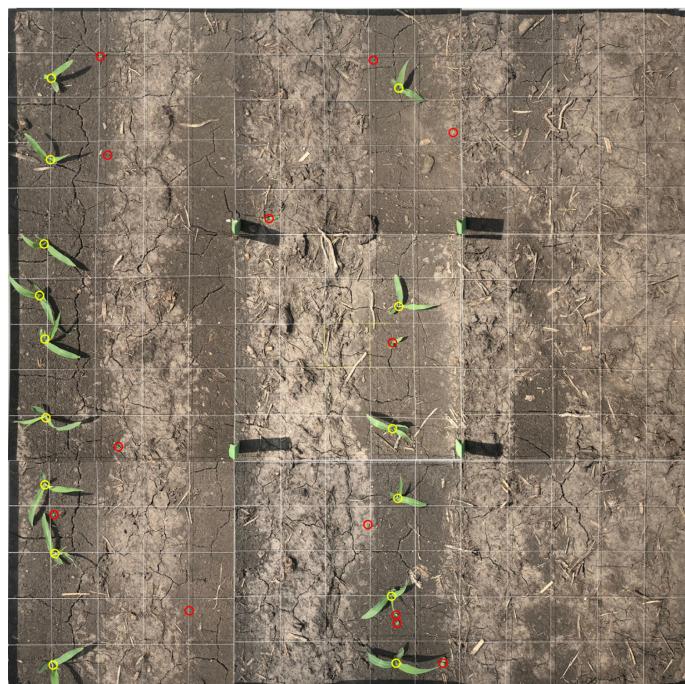
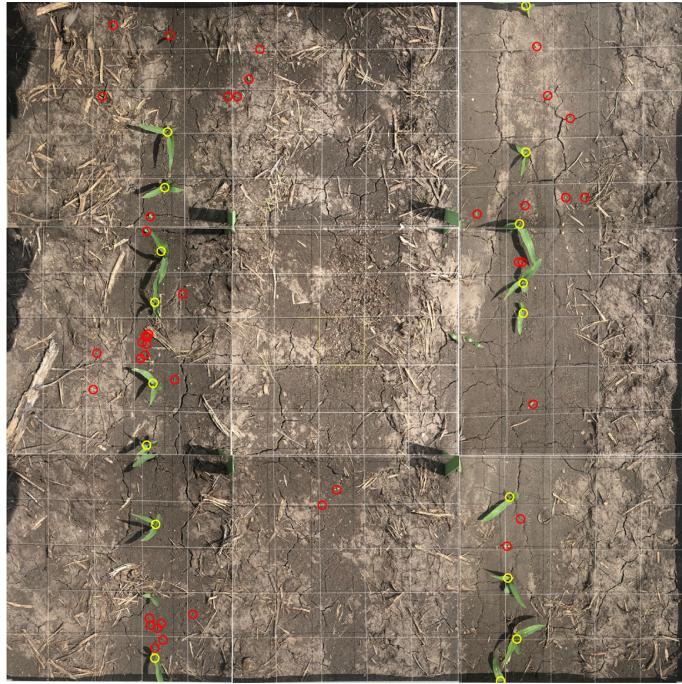


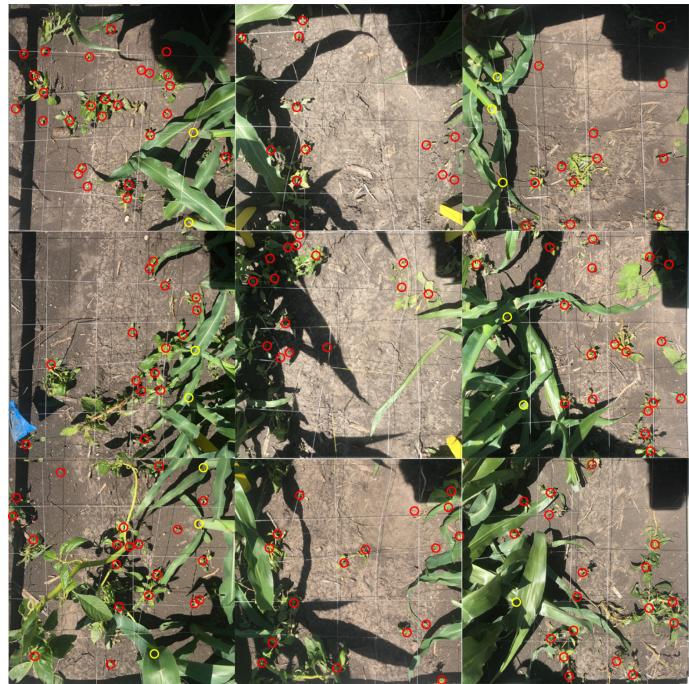
Figure 2: **Photo Mosaic For Plot 114 at One Week After Planting** The red circles represent weed seedling locations, and the yellow circles represent corn seedling locations.



**Figure 3: Photo Mosaic For Plot 207 at One Week After Planting** The red circles represent weed seedling locations, and the yellow circles represent corn seedling locations.



**Figure 4: Photo Mosaic For Plot 113 at Three Weeks After Planting** The red circles represent weed seedling locations, and the yellow circles represent corn seedling locations.



**Figure 5: Photo Mosaic For Plot 114 at Three Weeks After Planting** The red circles represent weed seedling locations, and the yellow circles represent corn seedling locations.



**Figure 6: Photo Mosaic For Plot 207 at Three Weeks After Planting** The red circles represent weed seedling locations, and the yellow circles represent corn seedling locations.

# Results

Table 1: Analysis for Plots 113, 114, and 207

Plot	Time Post Planting	Gini Coeff. (100 Px. Grid)	Gini Coeff. (500 Px. Grid)	Fractal Dim.
113	1 Week	0.0794	0.4286	0.5342
114	1 Week	4.8110e-16	0.3187	0.4770
207	1 Week	0.2827	0.4146	0.6188
113	3 Weeks	0.1137	0.5217	0.6379
114	3 Weeks	0.2146	0.1396	0.8204
207	3 Weeks	0.1951	0.2332	0.8214

## Conclusion

As seen in 1, the Gini Coefficients for the grid size of 500 pixels are more stable. We observe that between the first and third weeks post planting, the Gini Coefficient for plot 113 increases, while the Gini Coefficients for plots 114 and 207 decrease. This may be due to the fact that the Gini Coefficient is a measure of the relative dispersion between the populations sampled, in this case regions of the field. The unequal trends between the plots may be due to the fact that plot 113 becomes more patchy between the first and third week, even though the weeds are growing, while plots 114 and 207 become so dense that they cease to be as patchy. On the other hand, the Fractal Dimension tells us how completely the weeds fill the space sampled. The consistent increase between the the first and the third weeks for all the plots confirms that the weeds begin to fill the space of the plot as they grow.

## Future Work

As seen in 1, both the Gini Coefficients and the Fractal Dimension for plots 114 and 207 are quite similar. In the future, we may attempt to predict the density of an unobserved plot via measurements from an observed plot, if we have noticed similarities such as this. This will allow us to leverage spatial trends in weed growth to make density estimates useful for proactive weed management.

## References

Jacco Wallinga. The role of space in plant population dynamics: annual weeds as an example. *Oikos*, pages 377–383, 1995.

Andrew R Watkinson, Robert P Freckleton, and Lisa Forrester. Population dynamics of vulpia ciliata: regional, patch and local dynamics. *Journal of Ecology*, 88(6):1012–1029, 2000.

## Matlab Code

```
1 figure
2 %imshow( '113_1.bmp' )
3 %[x,y] = getpts
4 %%
5 figure
6 load( '113_1_data' )
7 hold on
8 scatter(corn_x,corn_y,'y','filled')
9 hold on
10 scatter(weed_x,weed_y,'r','filled')
11 print( '-bestfit' , 'BestFitFigure' , '-dpdf' )
12 %%
13 load( '113_1_data' )
14 scatter(weed_x,weed_y,1,'r','filled')
15 print( '-bestfit' , 'BestFitFigure' , '-dpdf' )
16 %%
17 load( '113_1_data' )
18 grid_size = 500;
19 dim = 1500;
20 iter = dim/grid_size;
21 xy = [weed_x, weed_y];
22 w = hist3(xy, [iter, iter]);
23 w = reshape(w, [], 1);
24 w = w(w ~= 0);
25 p = ones(length(w),1);
26 g = ginicoeff(p, w)
```