The seed column before post-harvest tillage was transitioned from post-harvest tillage through spring tillage with the general form of by Caswell (2001).

### Write the top stratum of the newly shuffled seed columns (from fall tillage through spring tillage) into a dummy matrix  
# https://community.rstudio.com/t/extract-matrix-rows-from-list/19357/2  
#https://stackoverflow.com/questions/29511215/convert-row-names-into-first-column  
  
mean\_after\_spring\_tillage\_pop\_scenario1\_top\_stratum\_df <- mean\_after\_spring\_tillage\_pop\_scenario1 %>%  
 map(~.x[1, ]) %>%   
 unlist(use.names = TRUE) %>%  
 as.data.frame() %>%  
 rownames\_to\_column("matrix\_id") %>%   
 rename(top\_stratum\_density = ".") %>%  
 mutate(top\_stratum\_female\_density = top\_stratum\_density/2) #assume 1:1 male:female  
  
  
#mean\_after\_spring\_tillage\_pop\_scenario1\_dummy <- lapply(split(mean\_after\_spring\_tillage\_pop\_scenario1\_df, mean\_after\_spring\_tillage\_pop\_scenario1\_df$matrix\_id),  
# function(x)(matrix(x$top\_stratum\_density, nrow = 6)))  
  
mean\_after\_spring\_tillage\_pop\_scenario1\_bottom\_stratum\_df <- mean\_after\_spring\_tillage\_pop\_scenario1 %>%  
 map(~.x[2, ]) %>%   
 unlist(use.names = TRUE) %>%  
 as.data.frame() %>%  
 rownames\_to\_column("matrix\_id") %>%   
 rename(bottom\_stratum\_density = ".") %>%  
 mutate(bottom\_stratum\_female\_density = bottom\_stratum\_density/2)

**include in the matrix assembly section**

5% of the waterhemp seeds in a soil seedbank of 5 cm deep that was undisturbed mechanically in the first burial year and unexposed to herbicides throughout the experiment, emerged a year after seed burial (Buhler and Hartzler 2001). Annually, 23.5% +/- 16.6% sd of waterhemp seeds that were not treated with herbicides and undisturbed mechanically emerged from the top 1 cm soil layer (Schutte and Davis 2014).

Mesotrione applied at 75 g/ha rate was 76% and 96% efficacious against *A retroflexus* L grown in corn that were susceptible and resistant to atrazine, respectively (**sutton2002activity?**). On average, the Thiencarbazone-methyl + isoxaflutole mixture was 93.5% efficacious and mesotrion was 70.75% efficacious against *A. palmeri* grown in corn (Janak and Grichar 2016).

The resistance profile of waterhemp at our experiment site was undetermined. We combined the findings on other *Amaranthus* species from (**sutton2002activity?**); Janak and Grichar (2016) for herbicide efficacy and from Buhler and Hartzler (2001) and Schutte and Davis (2014) for herbicide-unexposed germinants’ emergence and set a uniform germination rate at 10% from the 0 - 2 cm soil stratum for our waterhemp populations in all crop environments except for C4 under low herbicide management and A4 that followed both corn weed management regimes.

Seedling emergence proportions in the environments that were deemed too low were therefore adjusted to the equivalence 10% germination from the 0 - 2 cm soil stratum.

Table 1: Estimated and adjusted seedling emergence proportion with respect to the top 0 - 2 cm soil stratum and the whole seedbank (20 cm deep) using 2019 stratified soil seedbank densities and 2020 seedling emergence densities.

|  |  | Estimated total emergence proportion with respect to | |  | Adjusted total emergence proportion with respect to | |
| --- | --- | --- | --- | --- | --- | --- |
| Crop ID | Corn weed management | top 0 - 2 cm | whole seedbank | adjuster | top 0 - 2 cm | whole seedbank |
| C2 | conventional | 0.0024 | 0.0008 | 41.3096 | 0.1000 | 0.0314 |
| C2 | low | 0.0109 | 0.0033 | 9.1380 | 0.1000 | 0.0303 |
| S2 | conventional | 0.0637 | 0.0179 | 1.5704 | 0.1000 | 0.0281 |
| S2 | low | 0.0248 | 0.0086 | 4.0351 | 0.1000 | 0.0348 |
| C3 | conventional | 0.0073 | 0.0017 | 13.6860 | 0.1000 | 0.0236 |
| C3 | low | 0.0298 | 0.0067 | 3.3584 | 0.1000 | 0.0224 |
| S3 | conventional | 0.0374 | 0.0063 | 2.6756 | 0.1000 | 0.0167 |
| S3 | low | 0.0234 | 0.0048 | 4.2751 | 0.1000 | 0.0207 |
| O3 | conventional | 0.0030 | 0.0005 | 33.1797 | 0.1000 | 0.0167 |
| O3 | low | 0.0033 | 0.0005 | 30.3782 | 0.1000 | 0.0165 |
| C4 | conventional | 0.0587 | 0.0121 | 1.7036 | 0.1000 | 0.0207 |
| C4 | low | 0.1997 | 0.0404 | 1.0000 | 0.1997 | 0.0404 |
| S4 | conventional | 0.0010 | 0.0002 | 96.4479 | 0.1000 | 0.0183 |
| S4 | low | 0.0011 | 0.0002 | 93.0563 | 0.1000 | 0.0187 |
| O4 | conventional | 0.0009 | 0.0004 | 110.0551 | 0.1000 | 0.0433 |
| O4 | low | 0.0009 | 0.0004 | 107.2800 | 0.1000 | 0.0474 |
| A4 | conventional | 0.3926 | 0.0126 | 1.0000 | 0.3926 | 0.0126 |
| A4 | low | 0.3517 | 0.0108 | 1.0000 | 0.3517 | 0.0108 |

# Multiply the raw with the adjuster  
female\_emerge\_prop\_20\_adjusted\_df <- female\_emerge\_prop\_20\_adjusted %>%  
 select(matrix\_id, adjuster\_,  
 cohort1\_mean\_prop\_wrt\_top : cohort6\_mean\_prop\_wrt\_top,  
 cohort1\_mean\_prop\_wrt\_whole : cohort6\_mean\_prop\_wrt\_whole) %>%  
 mutate(adjusted\_cohort1\_mean\_prop\_wrt\_top = adjuster\_\*cohort1\_mean\_prop\_wrt\_top,  
 adjusted\_cohort2\_mean\_prop\_wrt\_top = adjuster\_\*cohort2\_mean\_prop\_wrt\_top,  
 adjusted\_cohort3\_mean\_prop\_wrt\_top = adjuster\_\*cohort3\_mean\_prop\_wrt\_top,  
 adjusted\_cohort4\_mean\_prop\_wrt\_top = adjuster\_\*cohort4\_mean\_prop\_wrt\_top,  
 adjusted\_cohort5\_mean\_prop\_wrt\_top = adjuster\_\*cohort5\_mean\_prop\_wrt\_top,  
 adjusted\_cohort6\_mean\_prop\_wrt\_top = adjuster\_\*cohort6\_mean\_prop\_wrt\_top,  
 adjusted\_cohort1\_mean\_prop\_wrt\_whole = adjuster\_\*cohort1\_mean\_prop\_wrt\_whole,  
 adjusted\_cohort2\_mean\_prop\_wrt\_whole = adjuster\_\*cohort2\_mean\_prop\_wrt\_whole,  
 adjusted\_cohort3\_mean\_prop\_wrt\_whole = adjuster\_\*cohort3\_mean\_prop\_wrt\_whole,  
 adjusted\_cohort4\_mean\_prop\_wrt\_whole = adjuster\_\*cohort4\_mean\_prop\_wrt\_whole,  
 adjusted\_cohort5\_mean\_prop\_wrt\_whole = adjuster\_\*cohort5\_mean\_prop\_wrt\_whole,  
 adjusted\_cohort6\_mean\_prop\_wrt\_whole = adjuster\_\*cohort6\_mean\_prop\_wrt\_whole,  
 top\_mean\_remain\_prop = 1 - (adjusted\_cohort1\_mean\_prop\_wrt\_top +  
 adjusted\_cohort2\_mean\_prop\_wrt\_top +   
 adjusted\_cohort3\_mean\_prop\_wrt\_top +  
 adjusted\_cohort4\_mean\_prop\_wrt\_top +   
 adjusted\_cohort5\_mean\_prop\_wrt\_top +   
 adjusted\_cohort6\_mean\_prop\_wrt\_top))  
  
  
### Mean matrix list   
female\_emerge\_prop\_20\_adjusted\_df\_long <- female\_emerge\_prop\_20\_adjusted\_df %>%  
 select(matrix\_id, adjusted\_cohort1\_mean\_prop\_wrt\_top:adjusted\_cohort6\_mean\_prop\_wrt\_top) %>%  
 pivot\_longer(!matrix\_id, names\_to = "Cohort", values\_to = "adjusted\_mean\_emerge\_prop")  
  
  
  
female\_emerge\_prop\_20\_adjusted\_list <- lapply(split(female\_emerge\_prop\_20\_adjusted\_df\_long, female\_emerge\_prop\_20\_adjusted\_df\_long$matrix\_id),  
 function(x) rbind(cbind(matrix(c(1-sum(x$adjusted\_mean\_emerge\_prop), 0,0,1), nrow = 2, byrow = TRUE), matrix(0,nrow = 2, ncol = 6)),  
 cbind(matrix(x$adjusted\_mean\_emerge\_prop, nrow = 6, ncol = 1),matrix(0,nrow =6, ncol=7))))  
  
### Save adjusted emergence list   
saveRDS(female\_emerge\_prop\_20\_adjusted\_list, file="../2-Data/Clean/adjusted-mean-emergence-prop.RData")

Buhler, Douglas D., and Robert G. Hartzler. 2001. “Emergence and Persistence of Seed of Velvetleaf, Common Waterhemp, Woolly Cupgrass, and Giant Foxtail.” *Weed Science* 49 (2): 230–35. <https://doi.org/dmnt6f>.

Caswell, Hal. 2001. *Matrix Population Models: Construction, Analysis, and Interpretation*. Second. Sunderland, Mass.: Sunderland, Mass. : Sinauer Associates.

Janak, Travis W, and W James Grichar. 2016. “Weed Control in Corn (Zea Mays l.) As Influenced by Preemergence Herbicides.” *International Journal of Agronomy* 2016.

Schutte, Brian J., and Adam S. Davis. 2014. “Do Common Waterhemp (*Amaranthus* *Tuberculatus*) Seedling Emergence Patterns Meet Criteria for Herbicide Resistance Simulation Modeling?” *Weed Technology* 28 (2): 408–17. <https://doi.org/f54k2x>.