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SACRIFICIAL SEED'S IMPACT ON NATIVE SEEDLING ESTABLISHMENT IN PRAIRIE RESTORATION

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Background

Tallgrass prairie used to cover Iowa and much of the midwest. Now, only 3% of the land it formerly covered still has remnant prairie (Smith 1998). Many prairie restoration efforts are in place, but native prairie seed is extremely expensive. Two UNI master theses have found there is widespread seed predation in buffet style experiments. The goal of this experiment was to discover how cheap, sacrificial seed would impact native seedling establishment in prairie restoration. Our goal is to find a way to increase seedling establishment so more places can have the opportunity to restore prairies cost effectively.

Westerman et al. 2003 showed that you could measure seed predation through seedcards and using cages as controls. Riebkes et al. 2016 successfully used sacrificial seed to increase seedling emergence rates on a roadside planting. Animals want to maximize the rate of energy intake by hunting for the highest quality and most abundant food present in their environment. When their food source is low, or another higher quality or more abundant source appears, they will switch to the superior food source.

Methods

Study Site

- Research was conducted in 2020 at Irvine Prairie located at 1173 55th St, Dysart, IA 52224. The 31.2 hectare field is divided into five sections to be planted in consecutive years. (Figure 1)
- Native prairie seed was planted on March 31st, 2020 consisting of 75 native prairie species.
- 400 native prairie seed were planted per m^2, 6.7 kg/ha
- Six research plots were established measuring 40m by 40 m. They are placed in an array shown in Figure 1.
- Three of the plots were designated control plots and three plots were designated for sacrificial seed.

Sacrificial Seed

- The sacrificial seed mixture consisted of roughly equal proportions of five types of birdseed: *Panicum miliaceum* (white millet), *Sorghum bicolor* (sorghum), *Helianthus annuus* (black oil sunflower), Zea mays (cracked corn), and *Guizotia abyssinica* (nyjer thistle).
- The sacrificial seed treatment was applied to three designated plots (plots 2, 3, & 6). We dispersed the bird seed by hand as evenly as possible on April 7th, 2020, and April 9th, 2020.
- Birdseed was spread at 10 times the weight of the native prairie seed, 66.8 kg/ha

Seed Removal

- To assess granivory while we wait for the seedlings to emerge, we monitored the rate of seed removal from a series of "seedcards" using a buffet-style experiment (Westerman 2003).
- We used 30 healthy *Heliopsis helianthoides* seeds glued (3M Super 77 Multipurpose Adhesive Aerosol) to an 1/4 piece of 21.6 cm x 27.9 cm coarse sandpaper (3M Paper Sheet 346U, 36 Grit).
- 30 seeds were attached to the cards by layering aerosol spray adhesive, sprinkling seeds evenly and spaced out.
- Previous research suggests that the adhesive and sandpaper do not attract or deter predators from the seeds (Westerman 2003).
- Seedcards were adhered to the ground in the prairie with 5.1 cm roofing nails.
- A 10m by 10m section was measured and marked in the center of each of the 6 plots. (Figure 2)
- Within each 10m by 10m section, 20 seedcards were randomly placed along 5 transects.
- We built a seedcard control cage for each plot that held 8 seedcards. The cages were elevated off the ground, open to the elements, but surrounded by wire cage material to prevent predators. (Figure 3)
- We counted the seeds on the seedcards for each trial (Figure 4). For trials 1 and 2, there was evidence of insects getting into the cages and eating seeds (half eaten seeds and insects found in cages). For trial 3, we made modifications to the cages (adding insect sticky traps, TangleFoot Sticky Insect Barrier, and another layer of wire mesh). Seeds were then only impacted by the weather and not insects.
- Seedcard trials ran: #1 June 12th to June 22nd, 2020; #2 June 25th to July 2nd, 2020, and #3 July 9th to July 16th, 2020. All trials ran similarly, except we altered the seedcard cages in trial 3 to be more exclusive.

Seedling Establishment

- We counted the emerged native seedlings in each of the 6 sacrificial seed and control plots on July 14th and July 17th, 2020.
- We counted the native forbs and native grasses within a 0.25 m^2 metal frame placed at random coordinates in a 10m by 10m section in each plot. We collected 20 points of data from each plot.
- At this stage of growth, we were more confident identifying native forbs compared to native grasses.

Data Analysis

- We calculated the percentage of seeds removed from the seedcards for each trial.
- Trials 1 and 2 were calculated uncontrolled because their seedcard cages did not exclude insects. Trial 3 was calculated controlled (with the seedcard cages that excluded all predators).
- The mean of percent seeds removed from seedcards was calculated for each plot for each trial as well as the standard error.
- Correcting for controls equation of % Seeds Removed: (average of seeds left on control cards – amount of seeds left on the seedcard) / average of seeds left on control cards

Figures

Figure 1: Irvine Prairie map, plots in study are boxes 1-6

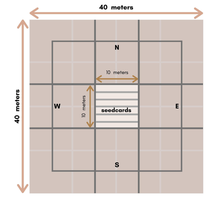

Figure 2: 40 m x 40 m plot, center 10 m x 10 m section held seedcards, seedlings were counted in one of the surrounding 10 m x 10 m sections

Figure 3: seedcard control cages, placed in each of the 6 plots with 8 seedcards per cage

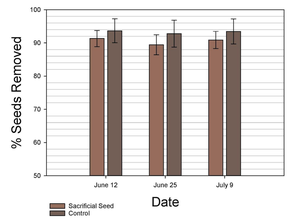

Figure 5: Percentage of seed removal from seedcards by predators in a planted prairie. 120 seedcards made using Heliopsis helianthoides were placed in six plots and counted by hand after a week of exposure. Control cages containing eight seed cards were placed at each plot, June 12th and June 25th controls were protected from mammals and birds and the July 9th controls were protected from all predators. Results show no significant difference between treated plots and control plots but show definitive predation of seeds in the prairie. Data shown as mean percentage of seeds removed from seedcards by predators adjusted for the effects of weather removal ± standard error.

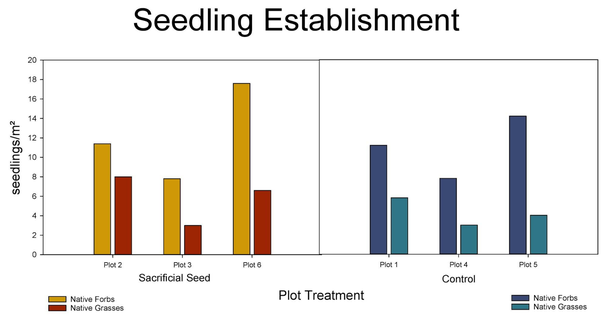

Figure 6: Comparative seedling establishment of native forbs and native grasses between control plots and sacrificial seed plots. 20 randomly selected points within a randomly selected 10m by 10m section of each plot were used to count emerging native forbs and grasses. Each point was sectioned using a 0.25m^2 metal frame as the border for counting. When comparing the control and sacrificial seed plots, it showed no significant difference. Data is shown as the number of emerging native forbs and grasses per m^2. Native grass data was generally lower than that of the forbs due to the nature of young grass seedlings being harder to identify and inexperience in identifying grasses.

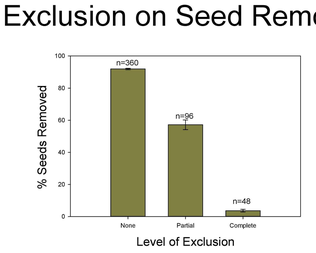

Figure 7: Percentage of seed removal from seed cards with varying levels of predator exposure. Although not a part of the experiment design, taking the data for seed removal from exposed seedcards with no protection (none), seedcards in the original control cages which excluded small mammals, earthworms, and birds but not insects (partial), and the modified control cages which excluded all seed predators (complete) shows a rough trend in the removal of seeds. Although no concrete conclusions can be drawn from this graph it does show a potential direction for future experiments looking at the predation levels from different granivores. Data is shown as mean percentage of seeds removed from seedcards with different exposure levels ± standard error. n has been included to show the large differences in the number of cards included at each exposure level.

Conclusion

Impact of Sacrificial Seed on Seed Removal from Seedcards

- It is clearly shown that seed predation is happening and it is very prevalent.
- No differences can be seen between the sacrificial seed and control plots. We did not expect any difference because of the time of planting vs. seedcard experiment. (Figure 4)

Impact of Sacrificial Seed on Prairie Seedling Establishment

- The results showed that the impact of sacrificial seed on native seedling establishment in prairie restoration is insignificant.
- There is little to no differences between the number of seedlings established in plots with sacrificial seed and plots with no sacrificial seed. (Figure 5)

Potential Impact of Excluding Seed Predators

- We found an unintentional exclusion comparison. There were 3 different treatments: one treatment excluded no seed predators and was affected by everything (the seedcards); one treatment excluded small mammals, birds, and earthworms and was affected by weather and insects (the faulty seedcard cages); one treatment excluded small mammals, birds, earthworms, and insects, and was affected by weather (the final adjusted seedcard cages).
- Each of these treatments has different amounts of data that were used to calculate their percent seeds removed, and they were conducted at separate but overlapping times.
- Despite the inconsistencies, the data collected and calculated can be a stepping stone for further research. (Figure 6)
- You can interpret the data as; roughly 30% (difference between "none" and "partial") of seeds are removed by small mammals, birds, and earthworms; roughly 55% (difference between "partial" and "complete") of seeds are removed by insects; and roughly 3% of seeds are removed by weather. The percentage left over is what seeds survived predation.

Figure 4: Counting seedcards, seeds had to be whole and undamaged to count as an unremoved seed

Future Direction

- Future research should look at the impact of different treatments that exclude predators. (only excluding mammals vs excluding everything, etc.)
- The impact of earthworms and fungi would also be beneficial to study.

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