The efficiency of different collection and sorting techniques on the seeds of *Galium boreale*

Ben Lee, Stuart Wagenius, The Echinacea Project, Chicago Botanic Gardens

Abstract

The Tallgrass prairies of Minnesota have been destroyed by agricultural overuse. In an attempt to revive the once bountiful prairies many organizations and individuals are looking into prairie restorations. It is important for prairie restorations to use local seeds which are adapted to the local environment to ensure the success of the restoration. Therefore it is necessary to find the most efficient method for collecting local seeds. The purpose of this experiment was to compare the efficiency of mechanical harvesting and sorting methods to hand harvesting and sorting methods on the native prairie plant *Galium Boreale*. Hand harvesting methods produced a significantly purer product before sorting. One person collecting with the vacuum harvester was not significantly different in its efficiency than two people hand harvesting. Mechanical sorting was significantly more efficient than hand sorting methods. Future studies are needed to determine if the vacuum harvester is as effective on other species of prairie plants and to determine if different burn times affect harvesting efficiency.

Introduction

Tallgrass prairies are one of the most fragmented and destroyed habitats in North America. In Minnesota alone They have been reduced by 99.6% from their historic levels (Samson and Knopf, 1994). Prairies have deep fertile soil which makes them good candidates for agriculture (Samson and Knopf, 1994). Recently, prairie restorations have become more common, thus the need for local seeds has increased (Gustafson et al, 2005).

Local seeds:

Seed mixtures in prairies vary greatly between regions, states, and countries. Each seed mixture must be tailored to a specific regions prairie as to not introduce non-native species that may become invasive. Local seeds are generally well adapted to the local environment (Gustafson et al, 2005). Local seeds have adapted their genotypes to best deal with the conditions and are therefore more likely to do better than those from distant sources (Mijnsbrugge et al, 2010).

Mechanical vs. Hand:

Hand harvesting is the most common way to gather native prairie seeds because it allows great control over what species are being harvested (Betz, 1986). Hand harvesting is labor intensive and can take up to 40 hours to gather a kilogram of seeds, however vacuum harvesting has been shown to gather one kilogram of seeds in eight hours (Stevenson et al, 1997). Mechanical harvesting can greatly increase harvesting efficiency.

Study Site:

The study was conducted at Hegg Lake Wildlife Management Area (WMA) with permission from the Minnesota DNR. The DNR conducted an experimental burn in the fall of 2014 on one portion of Hegg Lake and burned the rest of Hegg Lake in the spring of 2015. Seeds were collected from the fall burn area as the flowering timing was different between the two sections of Hegg Lake.

Figure 1. Hegg Lake WMA, the study site.

Our study:

The goal of this study was to accurately compare two harvesting methods which have similar applications and determine which method is most efficient at collecting the seeds of *Galium boreale.* We chose *Galium* because it is a common and widespread wildflower that can be used to increase the plant diversity of prairie restorations

Hypothesis

I hypothesized that using a vacuum harvester would be more efficient than hand harvesting methods. I also hypothesized that mechanical sorting would be much more efficient than hand sorting.

Methods

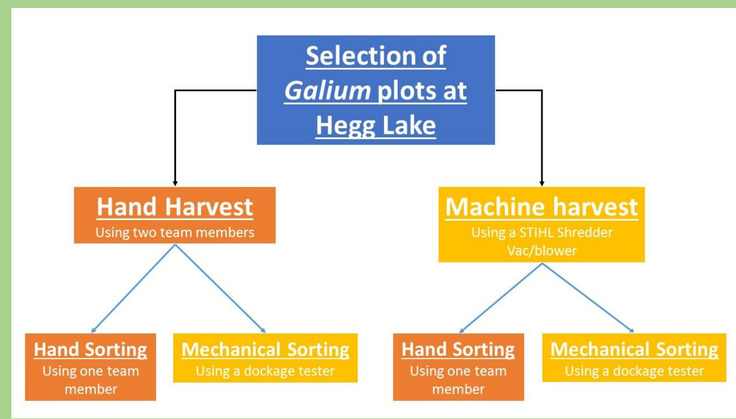

Figure 2. Six 10m X 10m plots were placed in an area of Hegg Lake WMA which was burned in the fall of 2014 and had plentiful populations of *Galium.* Three plots were randomly assigned to be machine harvested with a modified STIHL Shredder Vac/blower (known as a seed sucker) operated by one team member. Three other plots were harvested by two team members with harvesting buckets strapped around their waists. Out of the six total collections of seeds three were randomly assigned to be hand sorted and three were randomly assigned to be mechanically sorted using a dockage tester at a grain elevator. An efficiency metric of grams/min was developed and calculated. The results were compared using a two sample T-test.

Results

A total of 378g of *Galium* seeds were collected

Yield:

- Hand harvesting had a significantly higher percent yield than mechanical harvesting (p=0.001082, n=3)
- There was no significant difference between treatments in the amount (g) of seeds collected (p=0.4026, n=3)

Efficiency:

- There was no significant difference in efficiency between harvesting methods (p=0.3152, n=3)
- Machine sorting was significantly more efficient than hand sorting (p=0.03604, n=3)

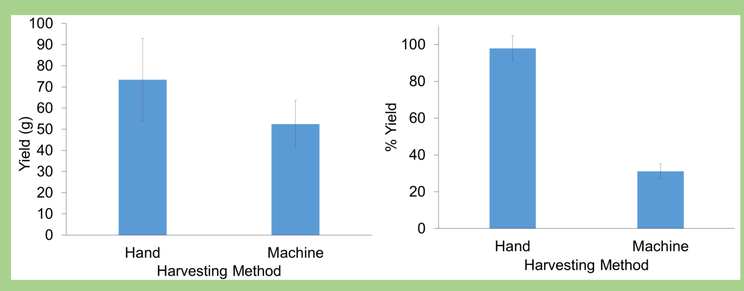

Figure 3. On the left is the mean yield in grams of each harvesting method (n=3, ±1 SEM). On the right is a comparison of the mean % yield of each harvesting method (n=3, ±1SEM).

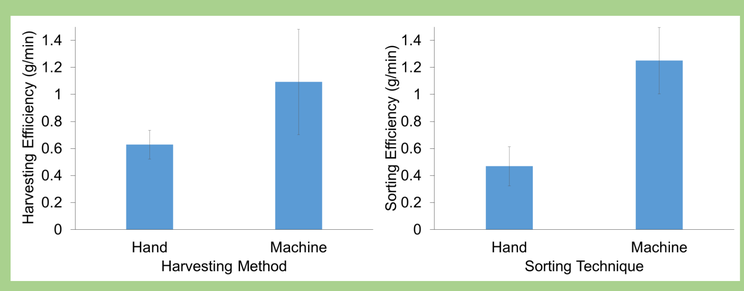

Figure 4. On the left is the mean efficiency (g/min) of the hand harvesting method as compared to the machine harvesting method (n=3, ± 1 SEM). On the right is the mean efficiency (g/min) of hand sorting compared to machine sorting techniques (n=3, ±1 SEM).

Discussion

The results of this experiment show that that the harvesting method was less important than the sorting method when comparing efficiency. There was no significant difference in efficiency between sorting methods. This means that a lone person with a seed sucker is not significantly less efficient than two people hand harvesting the same area. Therefore less people can be used to gather seeds from the same area without a loss in efficiency.

There was a significant difference in percent yield which points to a difference in purity levels between methods. On average the machine harvesting method had an average yield of 31% while hand harvesting had an average yield of 98%. Low yields from using the mechanical method presents a need for mechanical sorting methods to increase efficiency.

The results show that the seed sucker is a valuable tool that can be used to collect seeds when man power is low and mechanical harvesting methods are available. The seed sucker could potentially be used on terrain where it is not feasible to use a wheeled seed harvester.

Future experiments should look at how temporally different burn times effect harvest yields. They should also look to see how the seed sucker performs on plants other than *Galium*.

Figure 5. A flowering specimen of the study species *Galium boreale* (2015; Digital Atlas of the Virginia Flora, 2015)

Conclusions

We can conclude that the seed sucker is comparable in efficiency to two people hand harvesting and that mechanical sorting methods are very efficient and should be used when available.

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References

Betz, R. F. 1986. Two decades of prairie restoration at Fermilab Batavia, Illinois. *Proceedings of the Fifteenth North American Prairie Conerence* 15: 20-30.

Digital Atlas of the Virginia Flora. 2015. Galium boreale L. Website http://vaplantatlas.org/index.php?do=plant&plant=2764 [Accessed 21 September 2015]

Gustafson, D. J., D. J. Gibson, and D. L. Nickrent. 2005. Using local seeds in prairie restoration – data support the paradigm. *Native Plants* Spring: 25-28.

Mijnsbrugge, K. V., A. Bischoff, B. Smith. 2010. A question of Origin: Where and how to collect seed for ecological restoration. *Basic and Applied Ecology* 11: 300-31.

Samson, K., and F. Knopf. 1994. Prairie conservation in North America. *Bioscience* 44: 418-421.

Stevenson, M. J., L. K. Ward, and R. F. Pywell. 1997. Re-creating semi-natural communities: vacuum harvesting and hand collection of seed on calcareous grassland. *Restoration Ecology* 5:66-76.