Flash Forest

AFA DRONE SEEDING TRIAL SPRING 2024

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SUMMARY

01

One half of the dragged cutblock was treated with Flash Forest seedpods in May 2024

02

Seedling density was sampled with temporary and permanent plots.

03

Estimated average sph: 10,100: on track for full stocking

04

Significant difference between seed podded area and control area.

05

All counts done to the genus level, counts by species planned for Spring 2025.

PROJECT DETAILS

The cutblock was logged in 2023 and site prepared in the Fall of 2023.

Table 1: Project summary

Project date	May 18, 2024
Size	5 ha (2.4 ha control, 2.2 ha treated, 0.4 ha winter trial)
Species	100% Jack pine, SL 4804
Estimated pine density	10,100 sph (treated), 1,250 sph (control)
Estimated seed pod emergence rate	5.1% overall (approximately 903 sph), 6.2% for embedded pods (approx. 1097 sph)
Total seedpods	42,500
Seeds / pod	2
Seedpods / ha	17,700

Figure 1: Drone images of the site in March 2024. The scarification is clearly visible from the air.

This project intended to trial the efficacy of Flash Forest's seedpod technology on a site prepped, logged cutblock within FMU 451. The stand was Jack pine dominant before logging in 2023. It was then dragged by AFA in the Spring of 2023.

WINTER TRIAL

On March 15, 2024, Flash Forest manually installed five Permanent Sampling Plots (PSP) to trial winter deployment of seed pods. Each plot consists of two rows of twenty seedpods: one row with seedpods embedded into the ground and one row with seedpods dropped on the surface. Each seedpod was flagged with a pin flag. There was very little snow left at the time, but hand embedding was only partially possible due to the frozen ground conditions. Seeds in the seedpods were from the same seedlot as below.

SPRING TRIAL

Seedpods were prepared with Jack pine seeds provided by AFA in the Spring of 2024 and deployed on one half of the project site (2.4 ha) on May 18, 2024. Seedpods were manually embedded to simulate embedding by drone. At the time of seed pod deployment, Flash Forest installed five PSPs. Each plot consists of three rows of twenty seedpods, one row with embedded seedpods, one row with seedpods dropped on the surface and one row with bare seed.

On October 5th, 2024 Flash Forest staff assessed all ten PSPs and sixteen evenly distributed Temporary Sampling Plots (TSP) across the area treated with seedpods (2.4 ha) and the area left untreated (2.2 ha) (Figure 2).

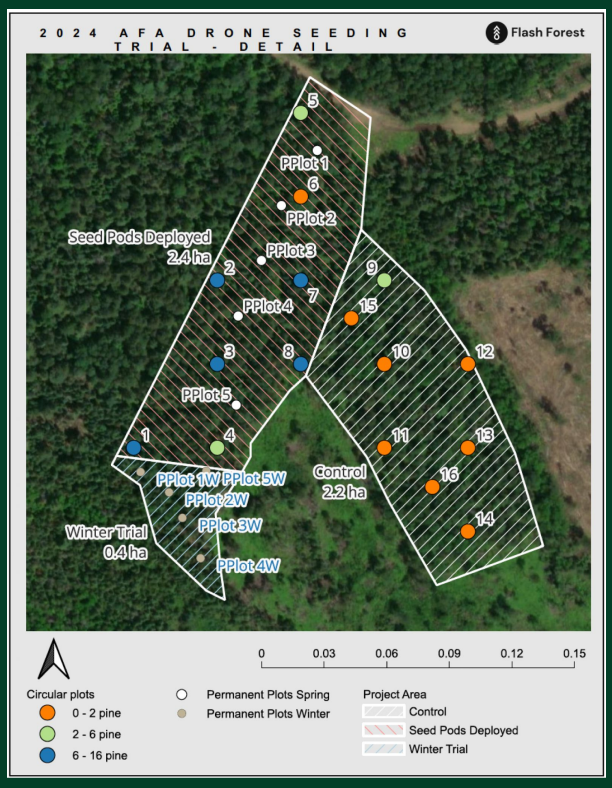


Figure 2: Overview map of the trial block. Flash Forest established five PSPs in March 2024 (Winter trial, PPlot 1W-5W) and five PSPs during seed pod deployment (Spring trial, PPlot 1-5). In October we assessed 16 TSPs (1-16). The circle color of TSPs represents the pine count for each plot.

FIRST SEASON MONITORING

Monitoring of the project included sampling of seedling density with circular TSPs (r = 1.78m) and assessment of germination rates for all PSP (Winter and Spring). One half the TSP were located in the area treated with seed pods and the other half in the control area. Basic summary statistics are included in this report for all TSP. Using a 10m2 plot, each seedling in a circular plot represents 1000 seedlings/ha and results in an estimated seedling density. Due to the small size in the first growing season, most seedlings can't reliably be identified to the species level. **First year seedlings were therefore assessed to the genus level**. This report only includes pine seedlings.

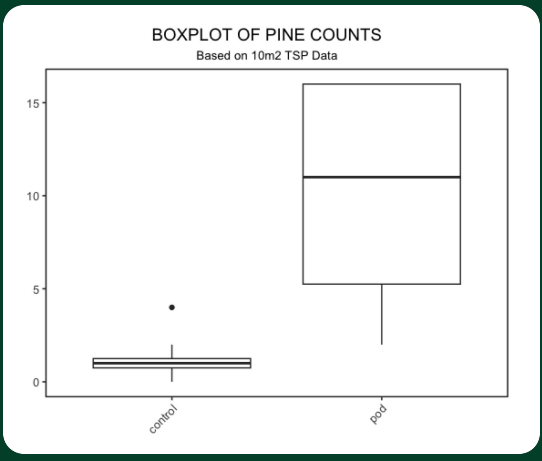
Additionally, emergence rates are included for all PSP.

> *Emergence Rate = pin flag with seedling / (pin flag with seedling + pin flag without seedling)*

Only seedlings within two inches of a pin flag were counted, to exclude potential natural seedlings and efforts were made to locate seedpod residue in edge cases. One row of bare seeds was excluded from the summary because of an excessive amount of natural seedlings in the area.

Both, the seedling density and emergence rate, was used to assess stocking of the trial area and to cross reference trends between both datasets.

TEMPORARY SAMPLING PLOTS: PINE COUNTS



The data showed significant differences between the treated (10.1 pine seedlings per plot) and control area (1.25 pine seedlings per plot) of the project. The mean seedling count was almost 10x higher in the treated area.

*Figure 3: Boxplot of the pine seedling counts per 10m2 circular plot. The lower and upper hinges correspond to the first and third quartiles (the 25th and 75th percentiles). The upper whisker extends from the hinge to the largest value no further than 1.5 * IQR from the hinge (where IQR is the inter-quartile range, or distance between the first and third quartiles). The lower whisker extends from the hinge to the smallest value at most 1.5 * IQR of the hinge. Data beyond the end of the whiskers are called "outlying" points and are plotted individually.*

Table 1: Summary statistics of temporary sampling plot data. The "control" area was not seeded or planted after site preparation, the "podded" area was treated with Flash Forest's seedpods at 17,700 pods/ha.

Treatment	N	Mean pines/plot	Min	Max	SD
Control	8	1.25	0	4	1.28
Podded	8	10.10	2	16	5.94

In addition to pine, most circular plots contained additional seedlings from at least four genuses (cedar, fir, spruce, poplar). Most notably, there was a significant amount of poplar in most of the project area. The southern corner closest to the treeline had higher numbers of cedar and fir seedlings.

PERMANENT SAMPLING PLOTS

Figure 4: Example of a PSP. Photo taken on October 5, 2024.

The results from five PSP are listed in table 2. The results indicate that there are differences between deployment types. The data highlights the importance of embedding seedpods as the emergence rate is higher for embedded pods. Data from Winter PSPs was averaged between both treatment types because Flash Forest staff were unable to embed a portion of the pods into the frozen ground.

Table 2: Summary statistics of results from two permanent sampling plot (PSP) trials. Spring 2024 PSPs were installed during the seed pod deployment, Winter 2024 PSPs were installed in March with little snowpack but onto frozen ground. BS = bare seed, DR = dropped pods, EM = embedded pods

Season	Deployment Type	Emergence Rate	SD	N
Spring 2024	BS	6.3%	4.8%	4
Spring 2024	DR	4.0%	2.2%	5
Spring 2024	EM	6.2%	9.4%	5
Winter 2024	DR + EM*	5.7%	7.3%	4**

** Embedding was only partially possible due to frozen ground. Consequently, we combined emergence rates for both treatments.*

*** We had established five PSPs in March as part of our winter trial, but pin flags for one plot got disturbed and we were not able to get an accurate count.*

INTERPRETATION AND RECOMMENDATIONS

01

Clear difference between control and treated area

The area treated with seedpods averaged an almost tenfold higher number of pine seedlings. This can be considered as an early indicator for success of the trial. However, follow up assessments will need to confirm the species.

02

Potential rationale for discrepancies

The emergence rate of 6.2% for embedded seedpods would represent about 1,100 in additional SPH but a near 10x increase was found. The small sample size in combination with a high standard deviation make the PSP data somewhat unreliable. Since different individuals placed the PSPs than those who embedded pods throughout the rest of the site, it is likely that there was some human error in the establishment of PSPs (poor or no embedding, or damage to sites during establishment of PSPs. It is possible that at least a small portion of the pine seedlings from our TSPs were natural seedlings of other species than Jack pine. The next assessment will bring more certainty.

03

Continued monitoring for two more years

As laid in the original plan, Flash Forest will continue monitoring the site for a total of three years to observe any trends and to confirm our initial assessment.

04

Poplar may need to be addressed

Portions of the project site had high densities of poplar which may compete with conifer seedlings. A treatment may be required.

APPENDIX 1: PINE SEEDLING PHOTOS

Pine seedlings were roughly 2-5 inches tall at the time of assessment and looked generally healthy. Below are a few examples of pine seedlings.