Coastal Resilience: The Environment, Infrastructure, and Human Systems, 2014, May 22

Restoration of halophyte communities in dredged material disposal place in South Korea

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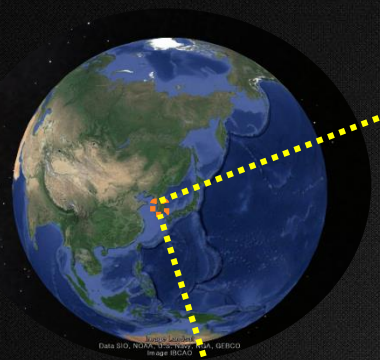
Introduction

The coastal ecosystems in S.Korea



West Sea
~80m
Mudflat

EastSea
~200m
Rocky shore

South Sea
~100m
Salt marsh

Coastal ecosystem degradation in S.Korea

Tide embankment

Secure land and fresh water

Reclamation

Heavy industry complex, Port

Total coastline is 6,236 km

20% of coastline is artificial

Coastal ecosystem degradation

Increasing risks of natural disaster

Coastal ecosystems restoration cases in S.Korea

1. Dyke breaching to restore natural water flow

2. Inter-tidal wetland restoration

3. Sand dune restoration

4. Seagrass habitat restoration
(Marine afforestation)

5. Halophyte community restoration

Cases for restoring coastal ecosystems in S.Korea

1. Dyke breaching to restore natural water flow

Constructed in 1960s

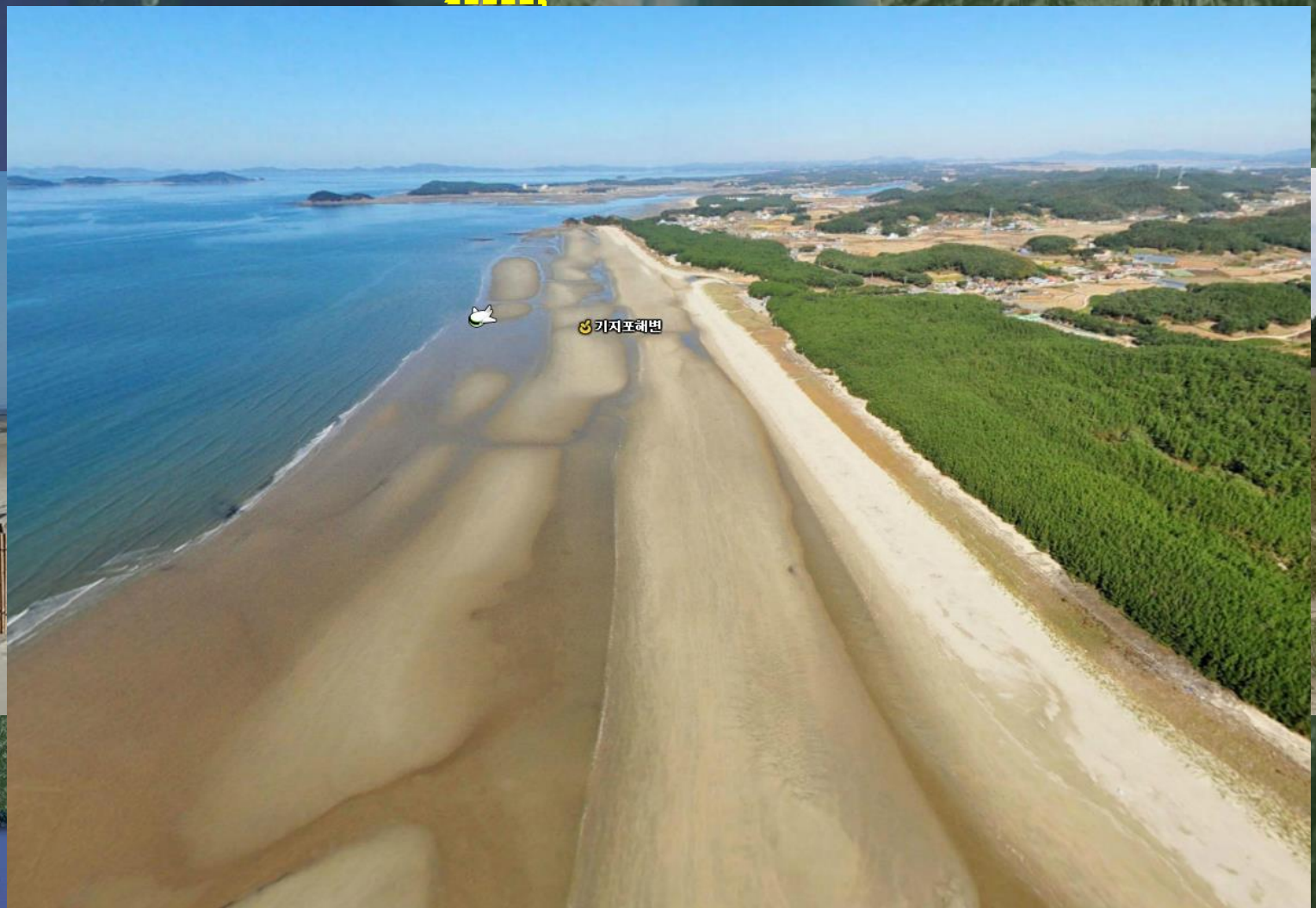
breached in 2010

Cases for restoring coastal ecosystems in S.Korea

2. Salt marsh restoration

Cases for restoring coastal ecosystems in S.Korea

3. Sand dune restoration

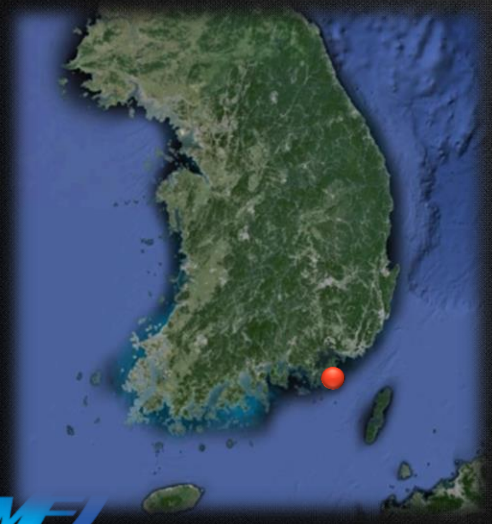


Cases for restoring coastal ecosystems in S.Korea

4. Seagrass habitat restoration

In soft bottom area
(west and south coast)

TERFS method



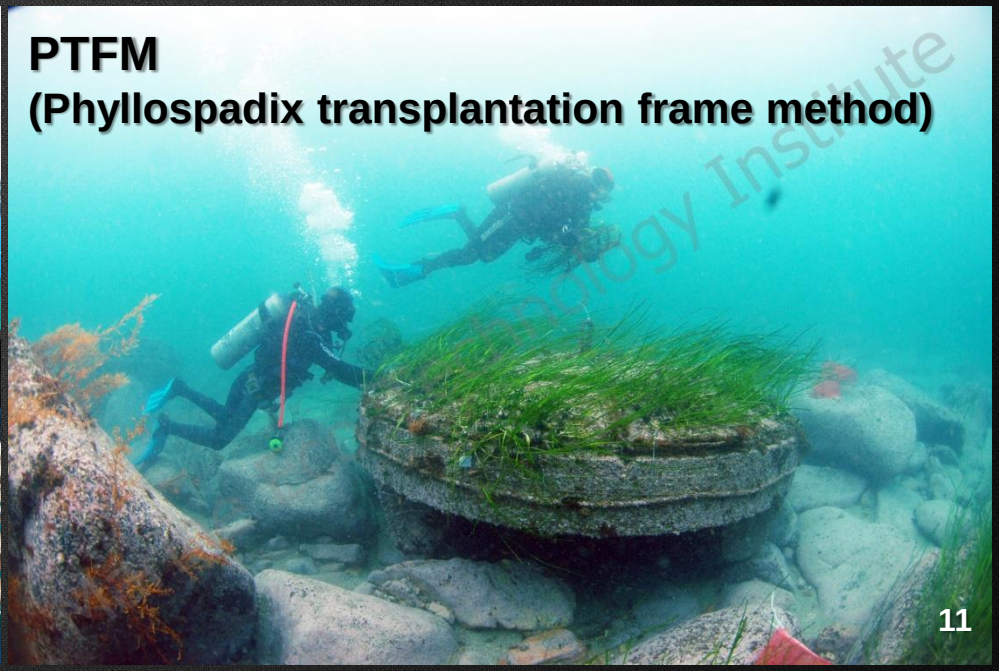
Staple method

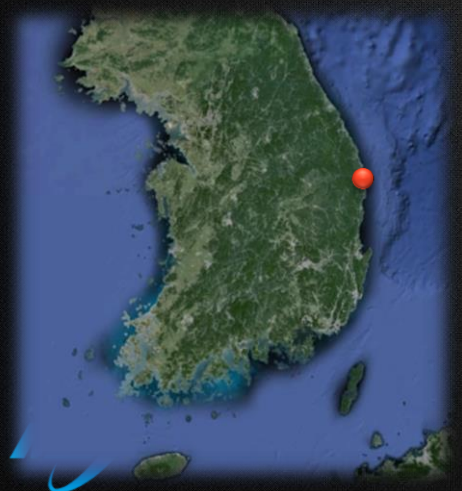
Shell method

Cases for restoring coastal ecosystems in S.Korea

4. Seagrass habitat restoration

In hard bottom area (East coast)





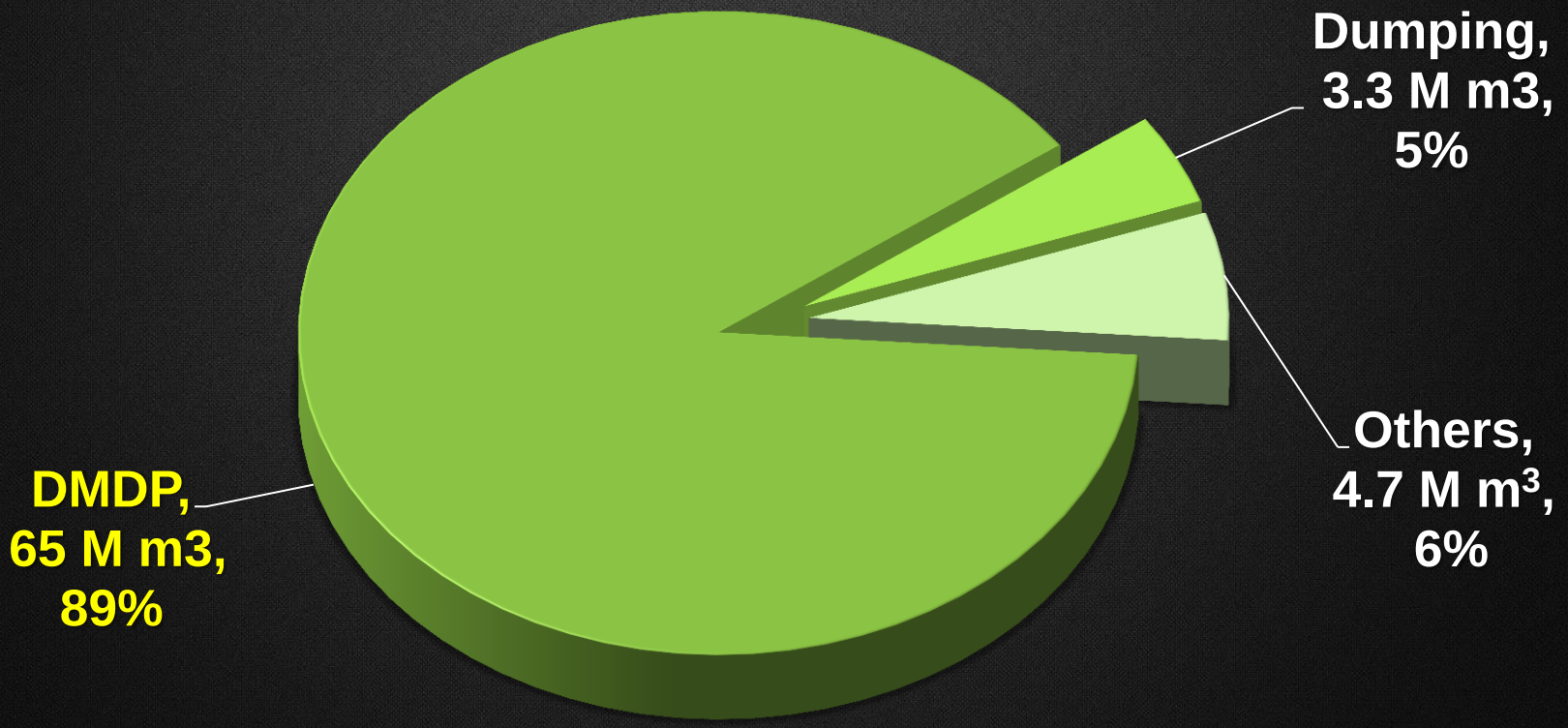
Both soft and hard bottom transplantation methods are our own technology patented in S.korea

Cases for restoring coastal ecosystems in S.Korea

5. Halophyte community restoration using dredged materials

Dredged materials production and disposal

- Average production quantity : 23,604,366 m^3/year
- 89% of dredged materials are disposed in DMDPs



Problems of dredged material disposal place

Outbreaks of nuisance midges

Potential use of DMDP

What are beneficial alternative plans for managing DMDP area ?

In recent years, municipal governments applying insecticide and soil covering to control this problem.

Halophyte community creation in DMDP to enhance landscape aesthetic and sediment stabilization

However, these kind of measures are not sustainable and effective

This is NEVER DONE before in S.Korea

Objective

Objective

To evaluate feasibility of halophyte community creation in DMDP

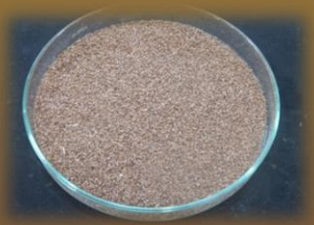
1. **Laboratory germination test** using dredged material to identify **optimum germination conditions**
2. **Mesocosm germination and growth test using various soils to find out optimum combination**
3. **Pilot germination and growth test in DMDP to evaluate its feasibility**

Materials & Methods

Target species selection

Native and dominant species in coastal area

Easily obtain seeds in Bulk



***Salicornia herbacea* L.**
Glasswort

Enhance landscape aesthetic

Salt and dry tolerance

Sample collection

- ✓ **Dredged Soils : Busan New port DMDP**
  - **Fresh dredged soil (FDS)**
  - **Old dredged soil (ODS)**
  - **Organic and inorganic chemicals in dredged soils were analyzed and all can be used for any landscape purposes**

- ✓ **Blending soils :west and south coast regions**
  - **Land soil (LS)**
  - **Mudflat soil (MFS)**
  - **Loess (RS)**

1. Laboratory test

1.1 Germination experiment

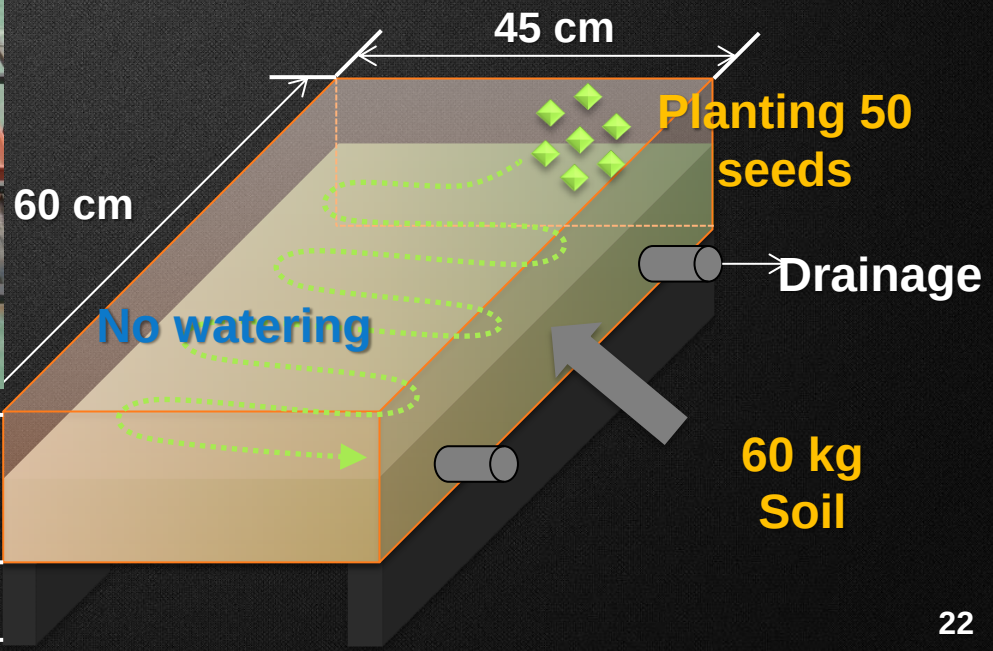
- **Effect of pretreatment of seeds on the germination**
  - ✓ Treatment : **Submerging** in freshwater (48h)
  - ✓ Control : **Non-submerging**
- **Effect of different concentration of salinity on the germination**
  - ✓ Treatment : 0.5, 3.2 % NaCl
  - ✓ Control : 0 % NaCl
- Experiments were conducted in growth chamber

2. Mesocosm Test

Outdoor mesocosm experiment was performed to find out optimum substrate for germination and growth

completely randomized block design

- ✓ FDS, ODS, MFS, LS
- ✓ ODS+MFS, ODS+RS, ODS+LS
- ✓ 7 soils, 4 replicate



3. Pilot Test

Location of the pilot site

3. Pilot Test

3.1 Pilot germination & growth experiment

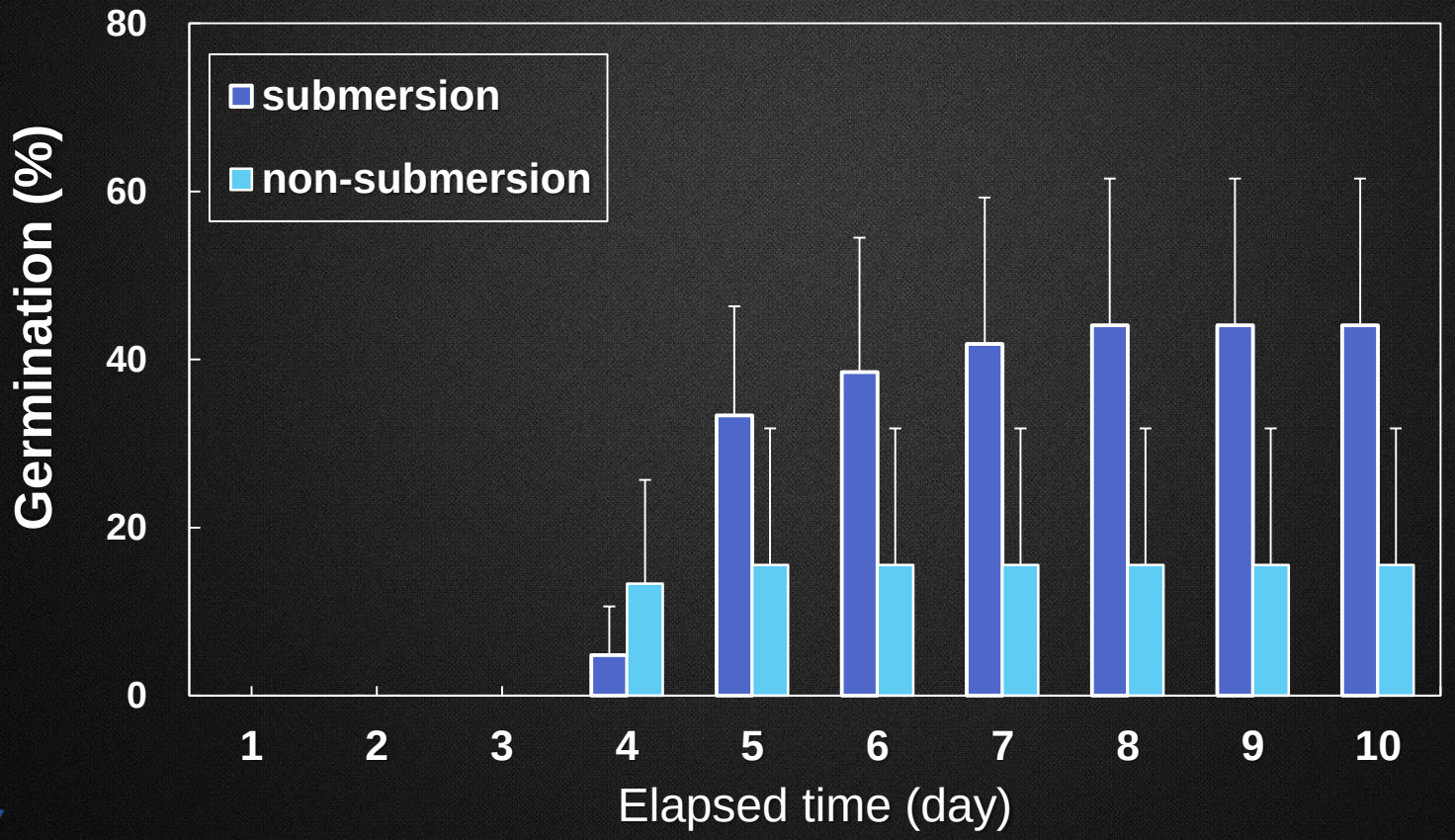
- **Experimental plot**
  - **Install 400 m^2 (20 X 20 m) of plot**
  - **Blend dredged soils in pilot site with Loess**
  - **Plant 40,000 seeds of *S. Herbacea* (100 seeds/m^2)**
- **Monitoring**
  - **Monthly appearance density and growth change**

Results

1. Laboratory Test

1.1 Effect of submerging pretreatment on germination

Significant difference between **submersion** and non submersion ($P<0.05$)



Average
44.1±5.82%

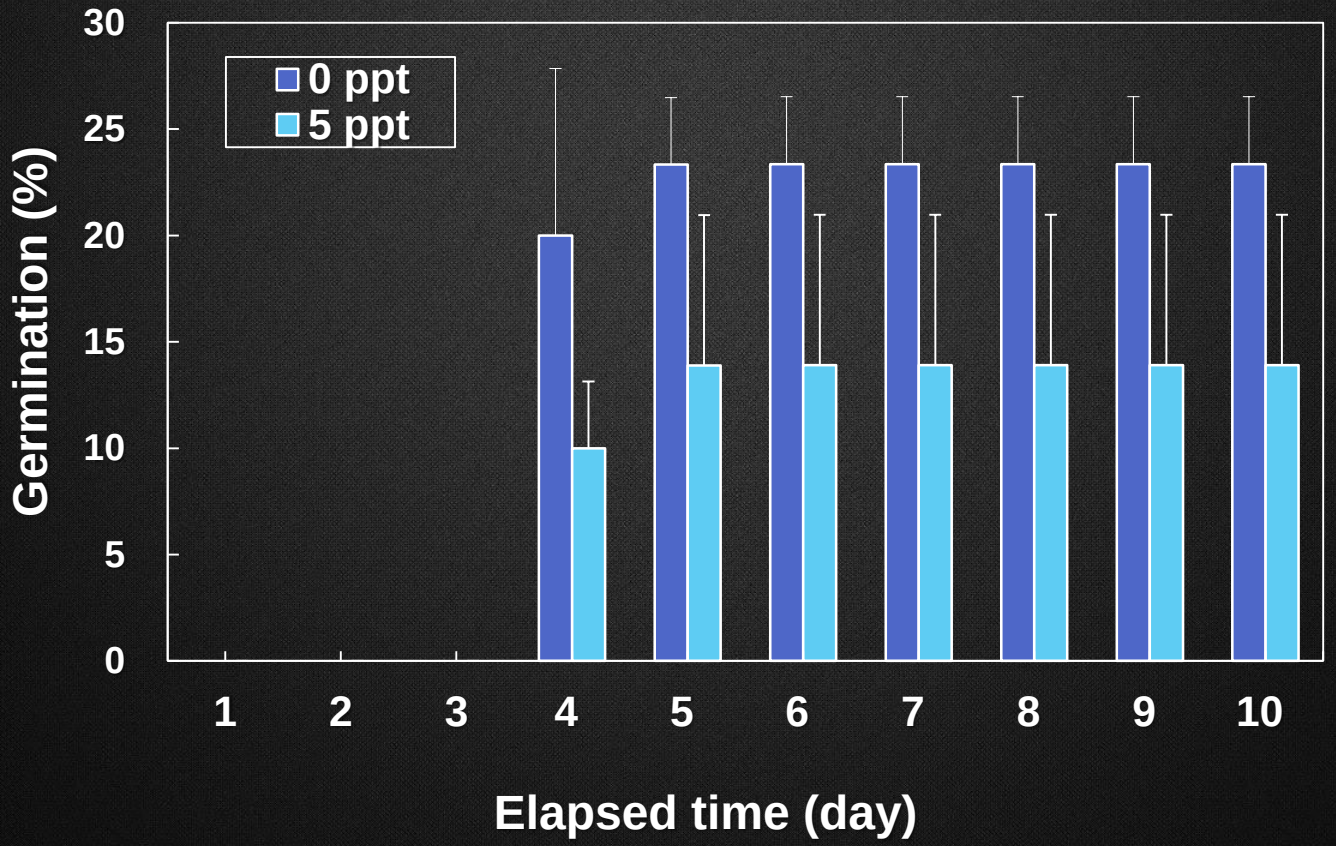
Average
15.6±5.41%

1. Laboratory Test

1.2 Effect of salt concentration on seed germination

Seed germination was not observed at 32ppt level

No significant difference between 0 and 5ppt (P > 0.05)



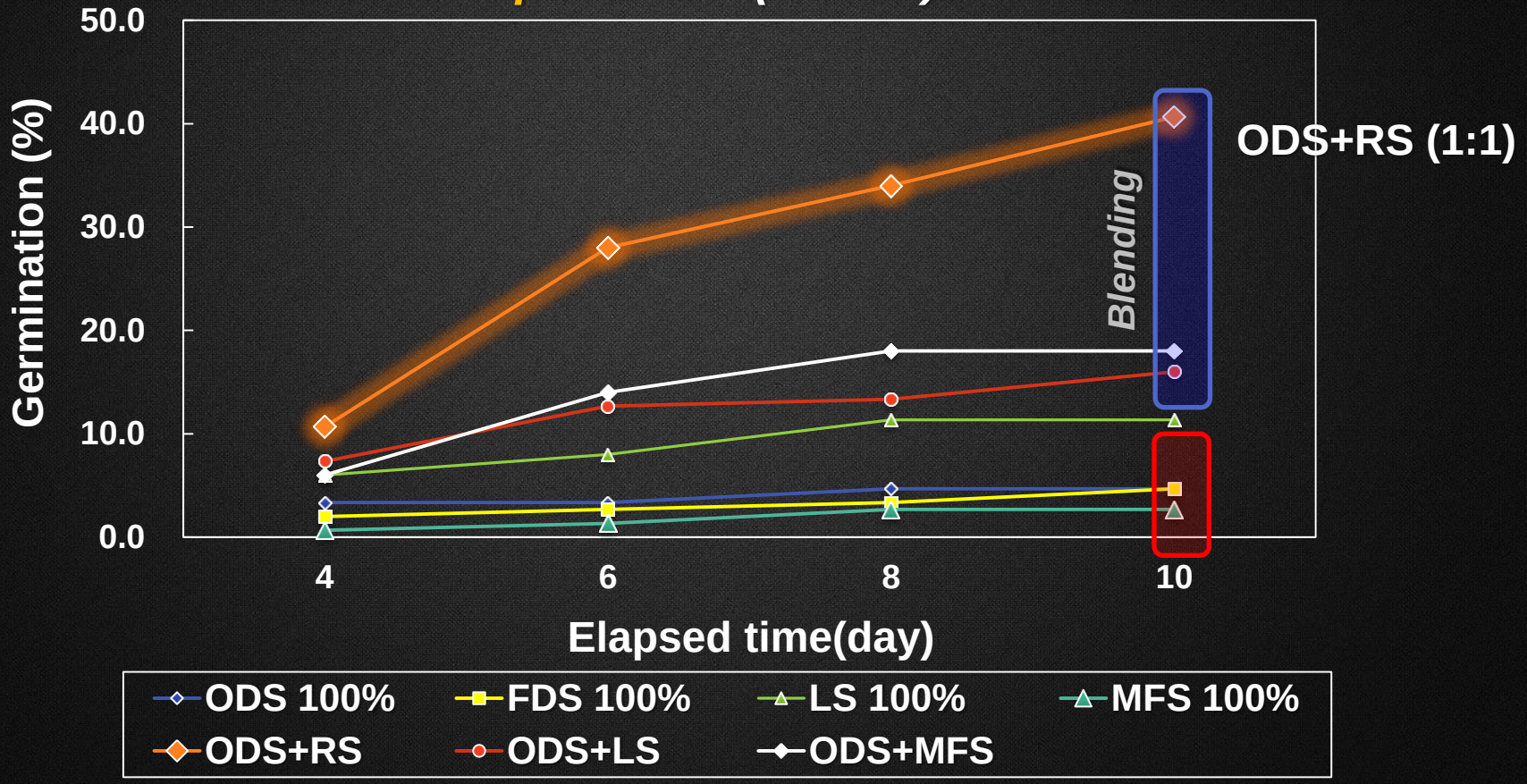
Average
22.9±1.27%

Average
14.3±1.47%

2. Mesocosm Test

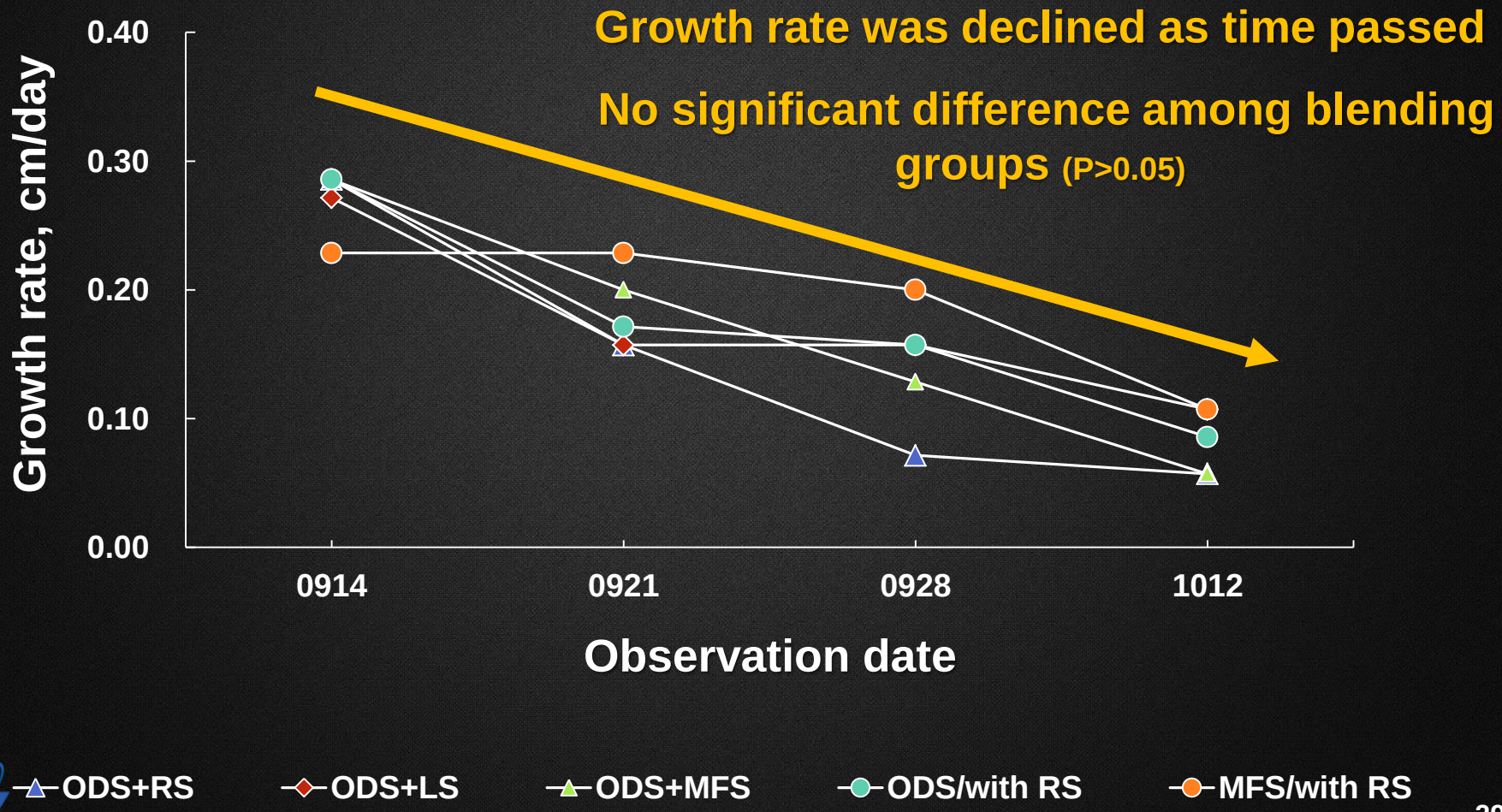
2.1 Effect of substrate blending on germination

Blending soils showed significantly higher germination rate than pure soils (P<0.05).



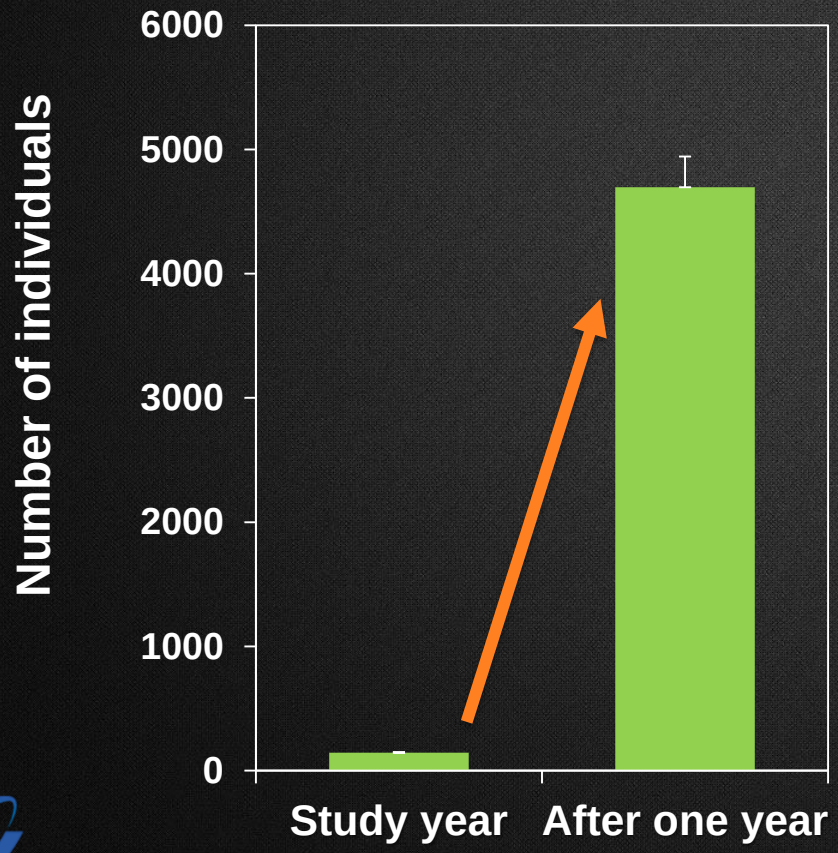
2. Mesocosm Test

2.2 Growth rate change in blending groups



2. Mesocosm Test

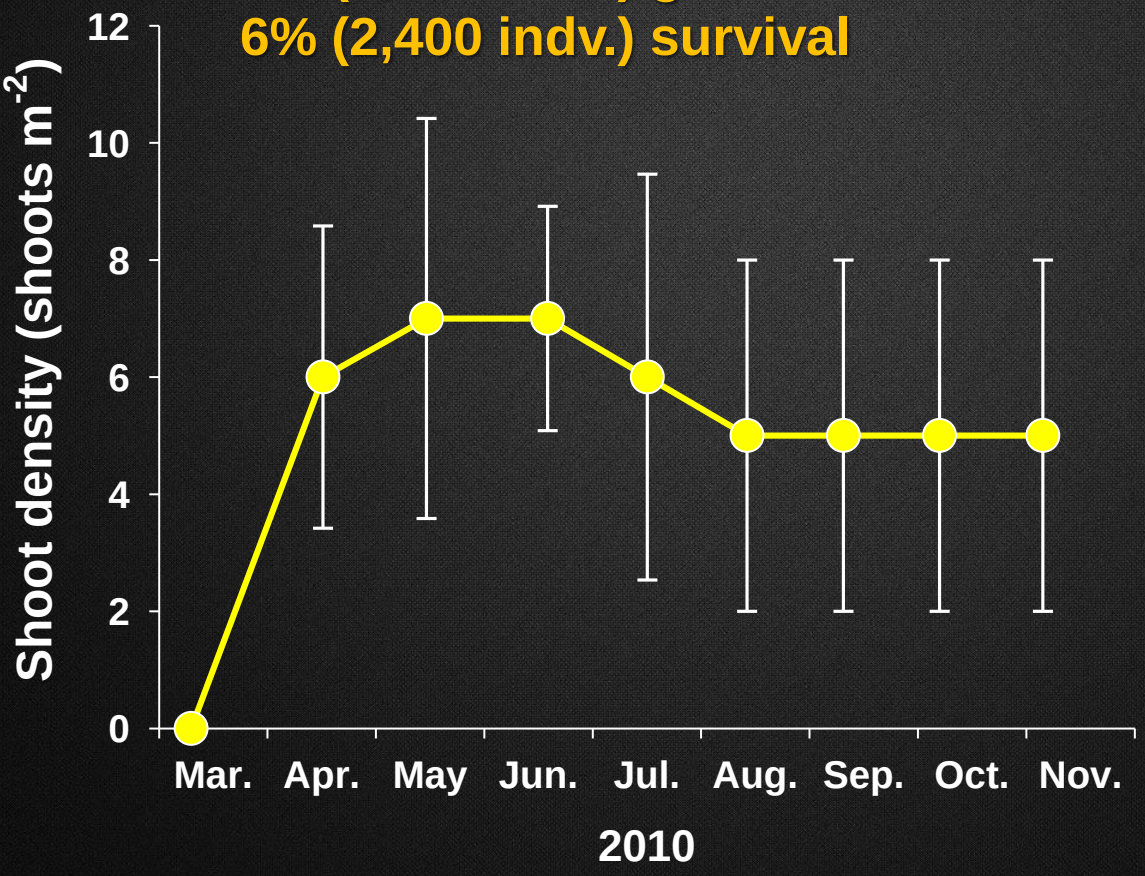
2.3 Assessment of natural succession possibility



3. Pilot Feasibility Test

Germination change in pilot site

7% (2,500 indv.) germination
6% (2,400 indv.) survival



Germination

Growth

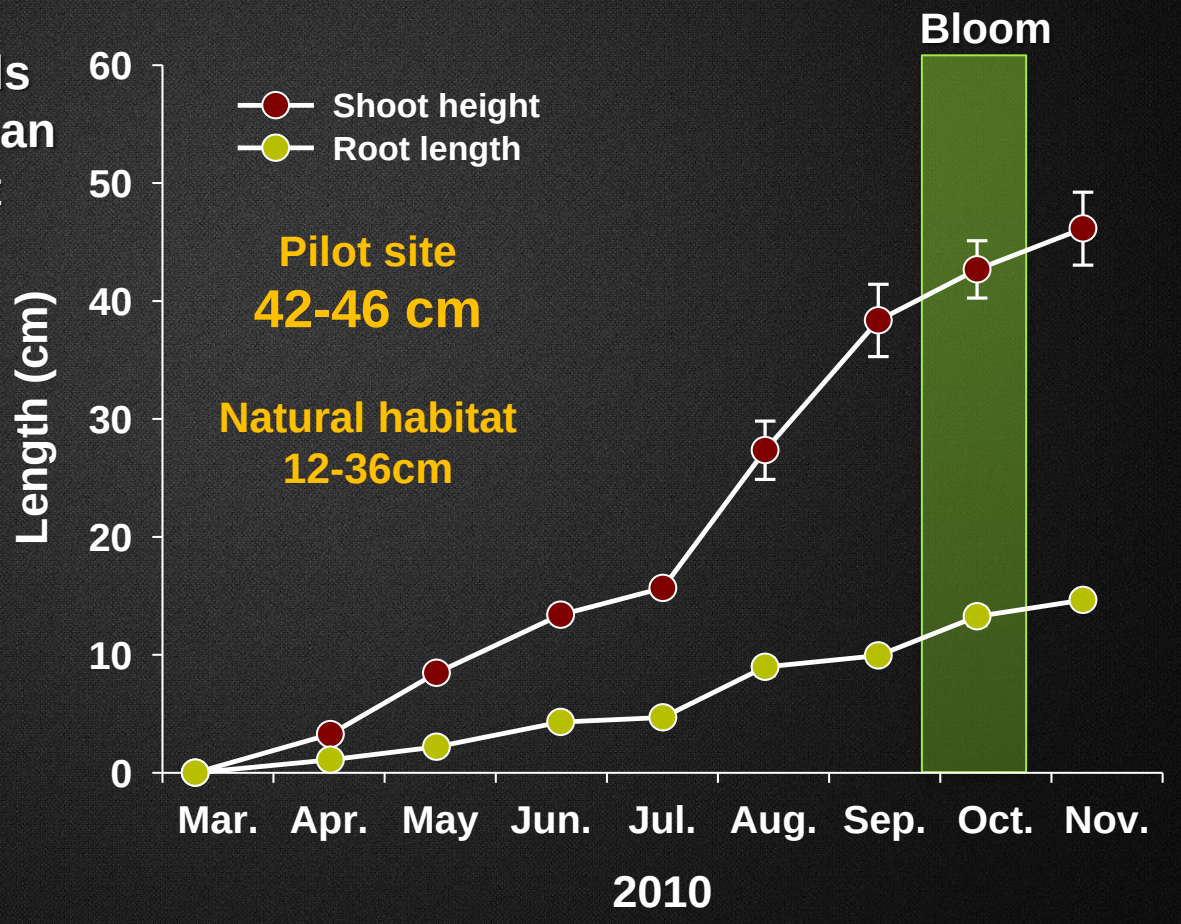
3. Pilot Feasibility Test

Growth change in pilot site

Average size of individuals in pilot site were higher than those in natural habitat

Natural habitat soil
LOI : 0.1-2.3%

Pilot site soil
LOI: 4.8-5.6%

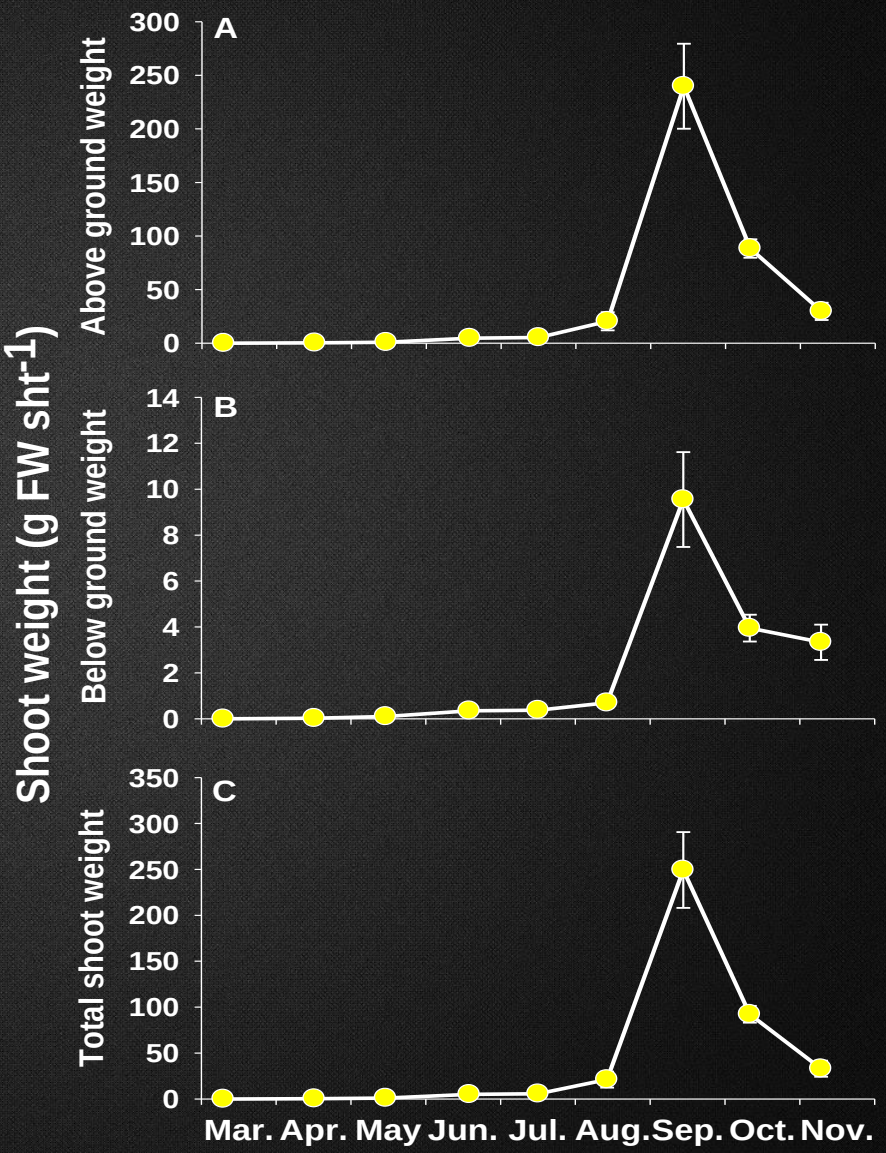


3. Pilot Feasibility Test

Biomass change in pilot site

Total biomass was highest on September and it was consistent with mesocosm results.

After September, *S.herbacea* started to change its green color to red and began to wither.



Summary

Summary

To evaluate the feasibility of creating halophyte communities in dredged material disposal place in south Korea

Laboratory, mesocosm and pilot scale of germination and growth test were performed using dredged materials and other soils

Through this study, we could make a small *Salicornea herbacea* community in dredged material disposal place

Study findings ;

1. Seed pretreatment by submersing in freshwater can increase germination rate

2. Seed germination was not significantly affected up to 5 ppt of salt concentration

3. Blend dredged material and loess is optimum substrate for seed germination

4. *S. herbacea* can produce lots of seeds, which could lead natural succession and could keep population density

Thank you for your attention

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