

# Banking Sagebrush Seed

Bob Karrfalt

Director National Seed Lab

USDA Forest Service

Clark Fleege

Nancy Shaw

# Why Bank Sagebrush Seed

- Seed Bank: long term seed storage (3 to 5+ years)
- Seed is banked:
  - In good seed years for use in poor seed years
  - To have a ready supply when seed is needed
    - Insures proper seed sources are available
    - Ensures timely availability of seed for direct seeding and nursery seedling production
- The need for seed continues to grow

# The Need for Sagebrush Seed

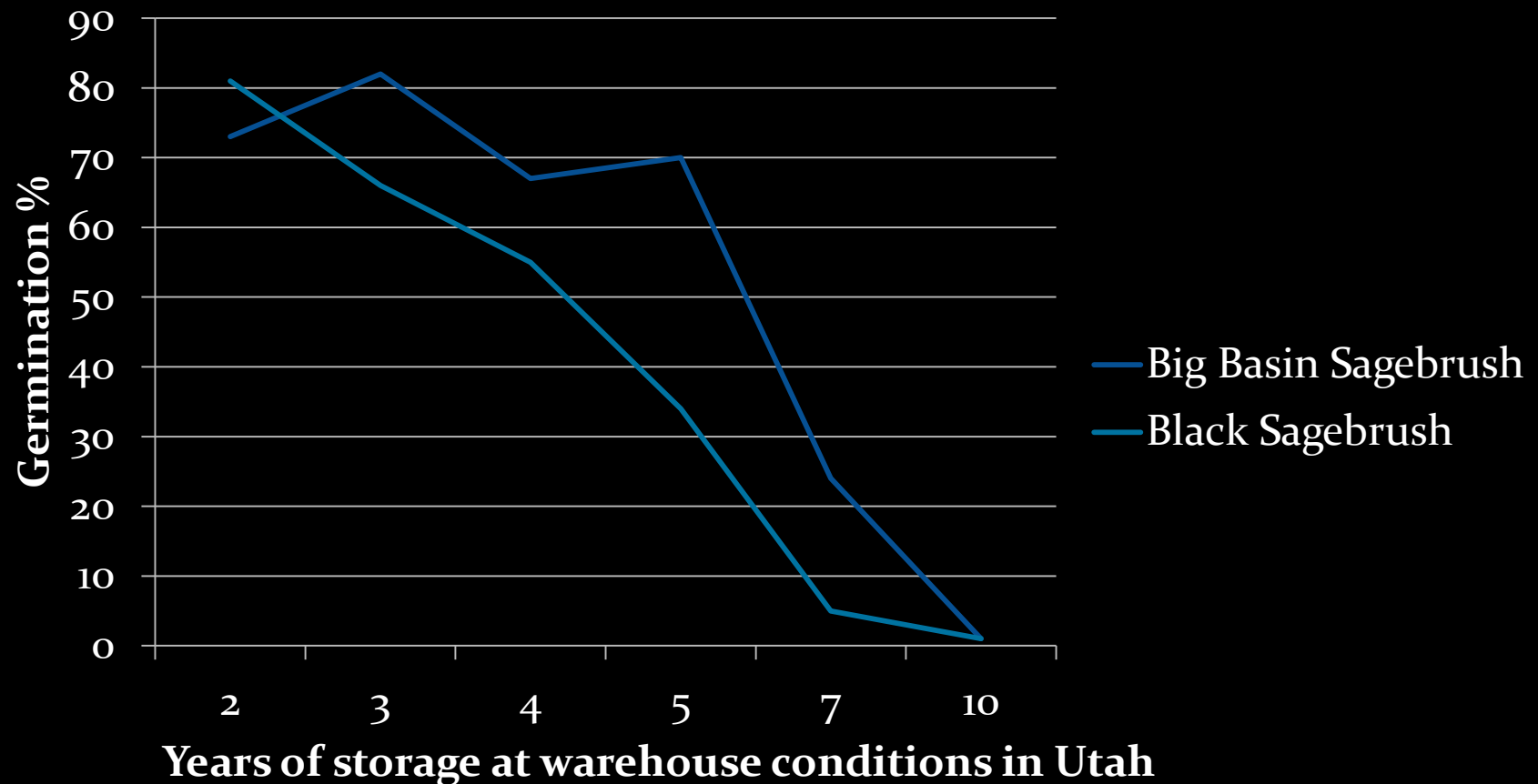
- Loss, degradation, and fragmentation of sagebrush habitat in the last 100 years
- Greater sage-grouse inhabits only 56% of its former range
- Restore 1 million acres (1MM)
  - 500 seedlings per acre = 500 MM seedlings = 625 MM seeds = 312 pounds (PLS)
  - 5,000 PLS per acre = .0025 pounds per acre = 2500 pounds (PLS) (50,000 pounds at 5% purity)

# Can Sagebrush Seed be Banked?

- Plus factors for banking sagebrush seed
  - Orthodox seed that can be dried to low moisture
  - Very small seed; large numbers fit in small space
- Negative factors for banking sagebrush seed
  - Relatively short shelf life under ambient warehouse conditions
    - Small (Few energy reserves)
    - non-dormant species (Starts using its reserves as soon as it starts to have moisture)

# Stevens, Jorgensen, Davis 1981

Great Basin Naturalist 41:274-277



# Storage in Sealed Containers

- An alternative to warehouse storage
- Keeps the moisture content low
- Allows for placing cold storage year round
- Works to preserve many orthodox species
- Study initiated in 2007

# Seed Materials

- 5 lots purchased from commercial supplier
- Each lot split in half (10 sub-lots)
  - Half cleaned to “high purity” (about 80%)
  - Half left as purchased “low purity” (mostly trash)
- Each sub-lot divided into 16 fractions (32 fractions total)
- 4 moisture levels: 30, 40, 50, 70% ERH
- 4 storage temperatures: 20, 2, -8, -20° C
- Sealed in 6 mil poly bags

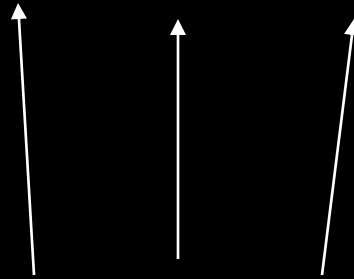
# ERH

- ERH – **E**quilibrium **R**elative **H**umidity
- Seeds will come to equilibrium with the moisture in their environment
  - 30% ERH: equilibrated at 30% relative humidity



Dry air (Relative humidity is  
below 30%)

Water leaves the seed  
and goes into the dry  
air.



Moist seed

Humid air (relative humidity  
is above 30%)

Water moves  
from the air  
into the dry  
seed.



To keep seeds dry  
they must be  
sealed in a  
moisture proof  
container.

Humid air (70%)

The diagram illustrates a state of equilibrium. At the top, a blue rectangular box is labeled 'Humid air (70%)'. Below it, a blue oval is labeled 'Moist Seed'. Between the box and the oval, there are four vertical arrows: two pointing upwards and two pointing downwards, representing the bidirectional movement of water. To the left of these arrows, the text 'Water moves both ways or not at all.' is written. The entire diagram is set against a black background with a decorative teal and black wavy border at the top.

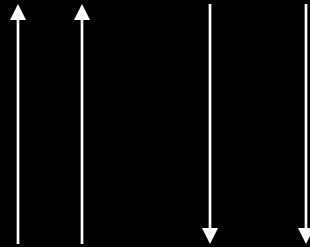
Water  
moves  
both ways  
or not at  
all.

Moist Seed

The condition of a high equilibrium relative humidity. At equilibrium this seed will measure an ERH of 70%.

Dry air (30% relative humidity)

Water  
moves  
both ways  
or not at  
all.



Dry Seed

The condition of a low equilibrium relative humidity. At equilibrium this seed will measure an ERH of 30%.



Probe



Sample holder

A water activity ( $A_w$ ) meter used to measure ERH.



Meter

Water  
Activity  
Meter

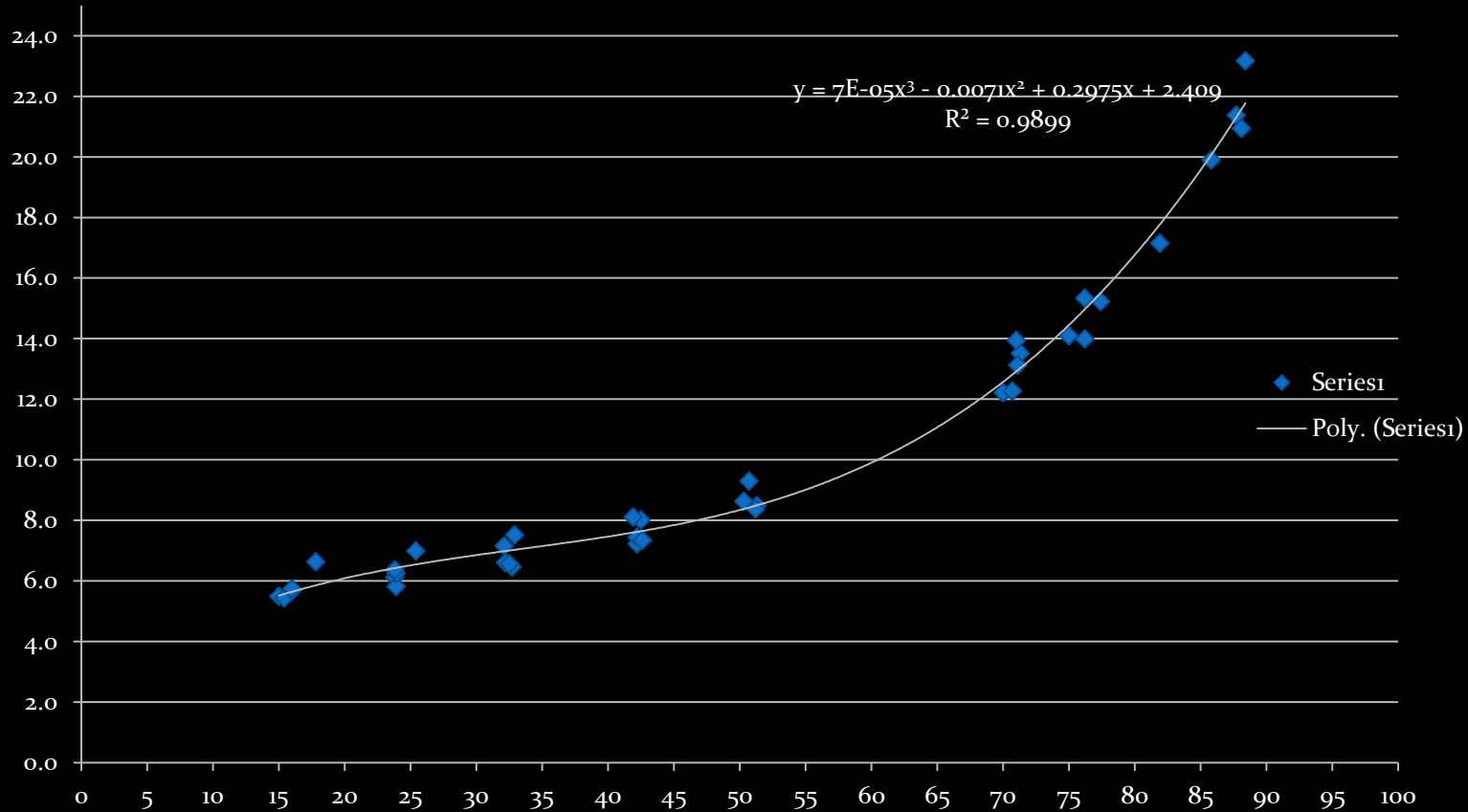


Hygrometer measuring ERH of seeds in a covered box





# Isotherm for Wyoming Big Sagebrush

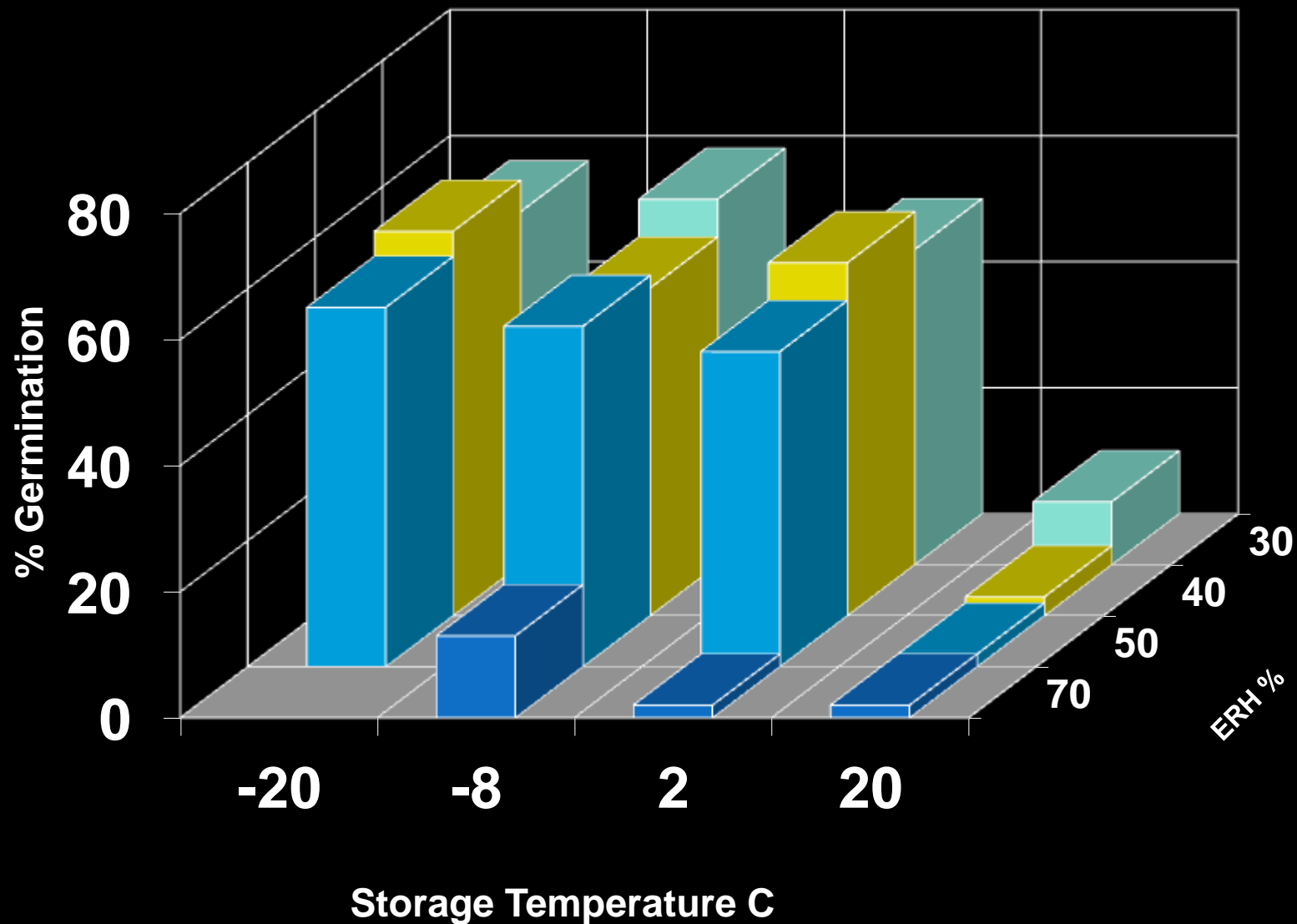




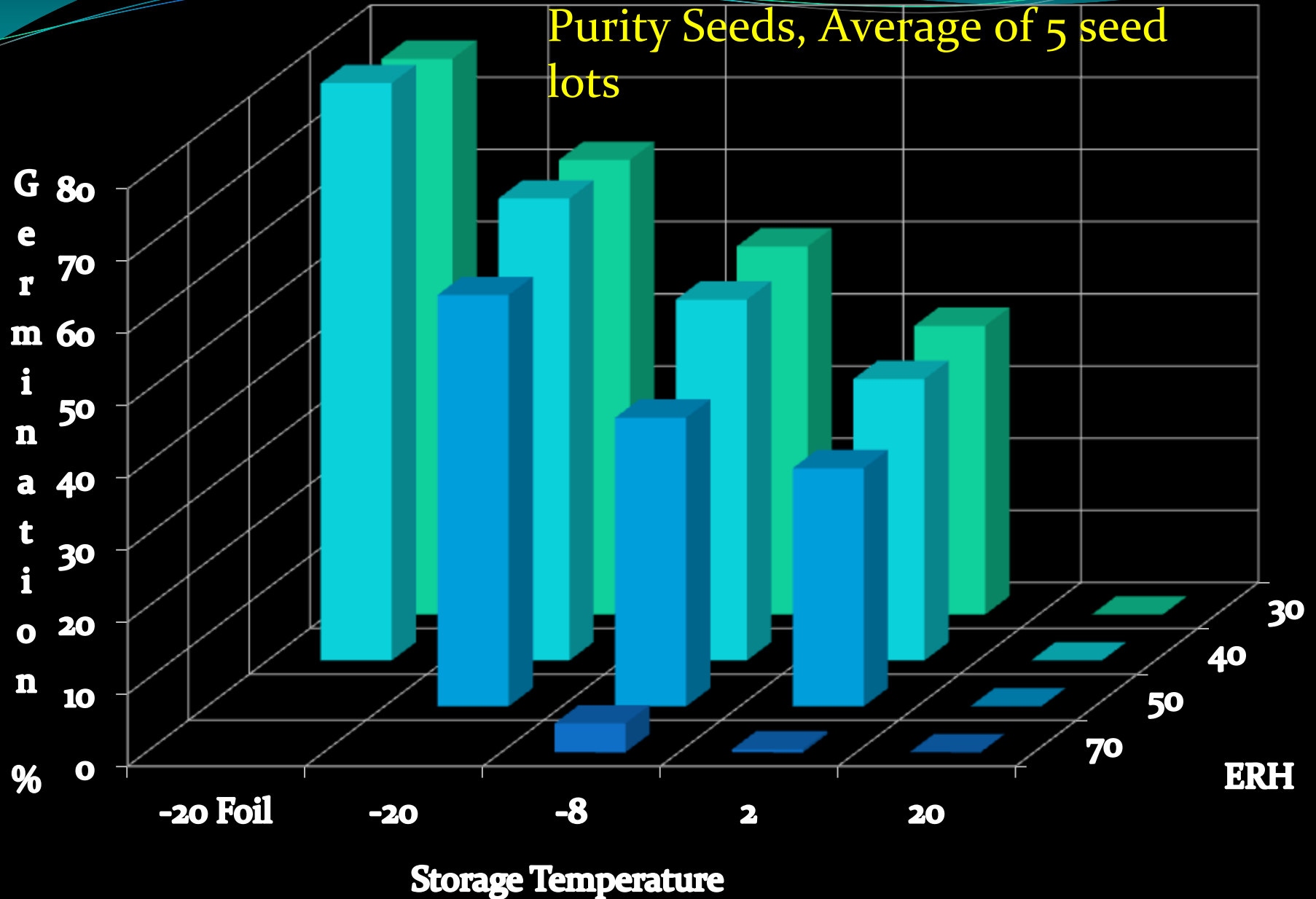
## Initial Seed Conditions: Moisture Content and Corresponding Equilibrium Relative Humidity, Germination

Lot Number	% MC	ERH %	Germination
CA2 high purity	6.6	32.5	48 %
ID high purity	6.8	39	35 %
WP high purity	7.3	39.4	56 %
HE high purity	7.4	44.7	52 %
U high purity	7.5	37.4	61 %      Avg 50.4
ID low purity	9.1	39.2	248 seedlings/gm
CA2 low purity	13.5	67.7	48 seedlings/gm
WP low purity	14.2	70.6	0 seedlings/gm
U low purity	14.2	72.6	0 seedlings/gm
HE low purity	14.9	72.2	0 seedlings/gm

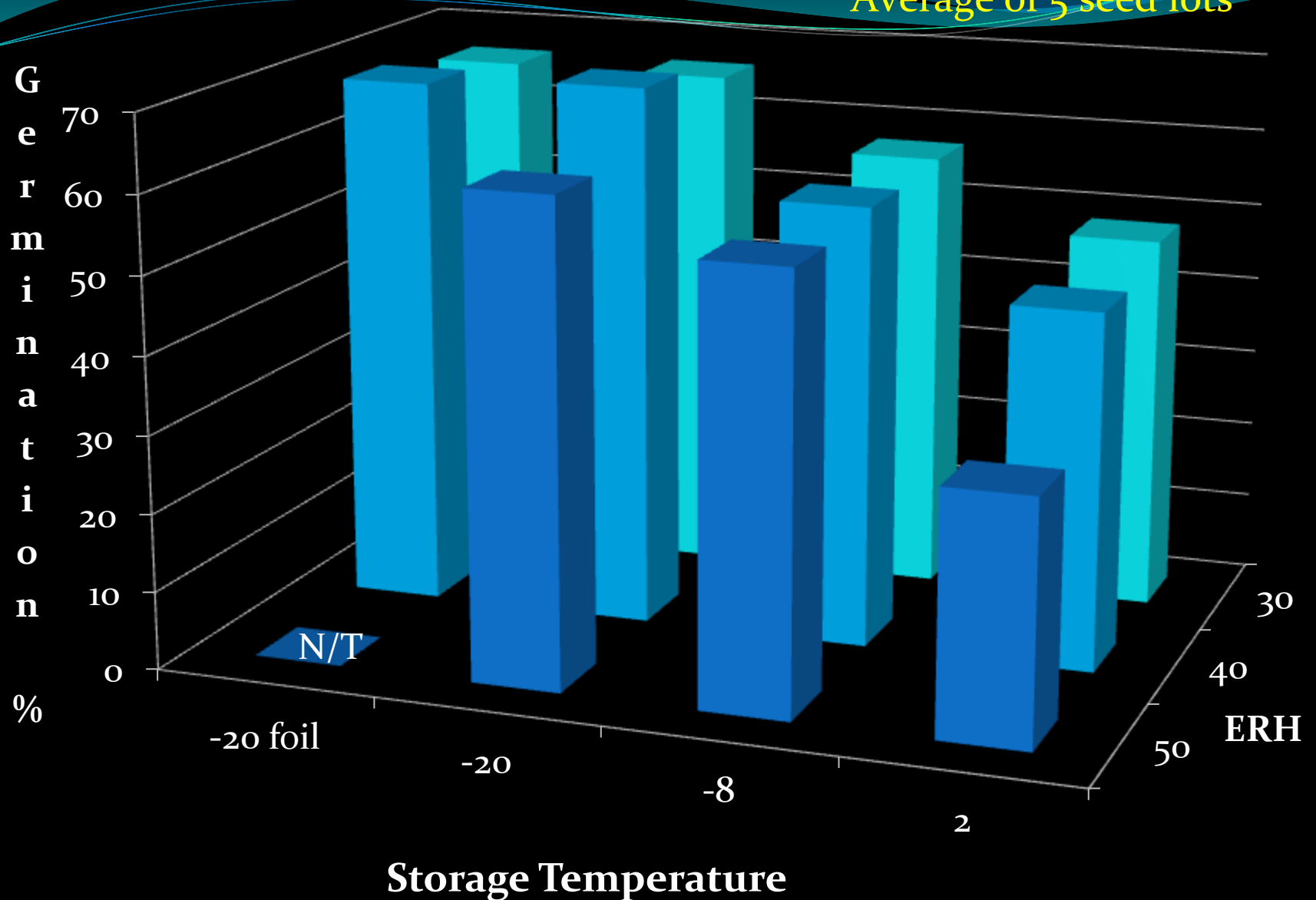
# Sagebrush Seed Storage Average of High Purity Seed Lots 15 months



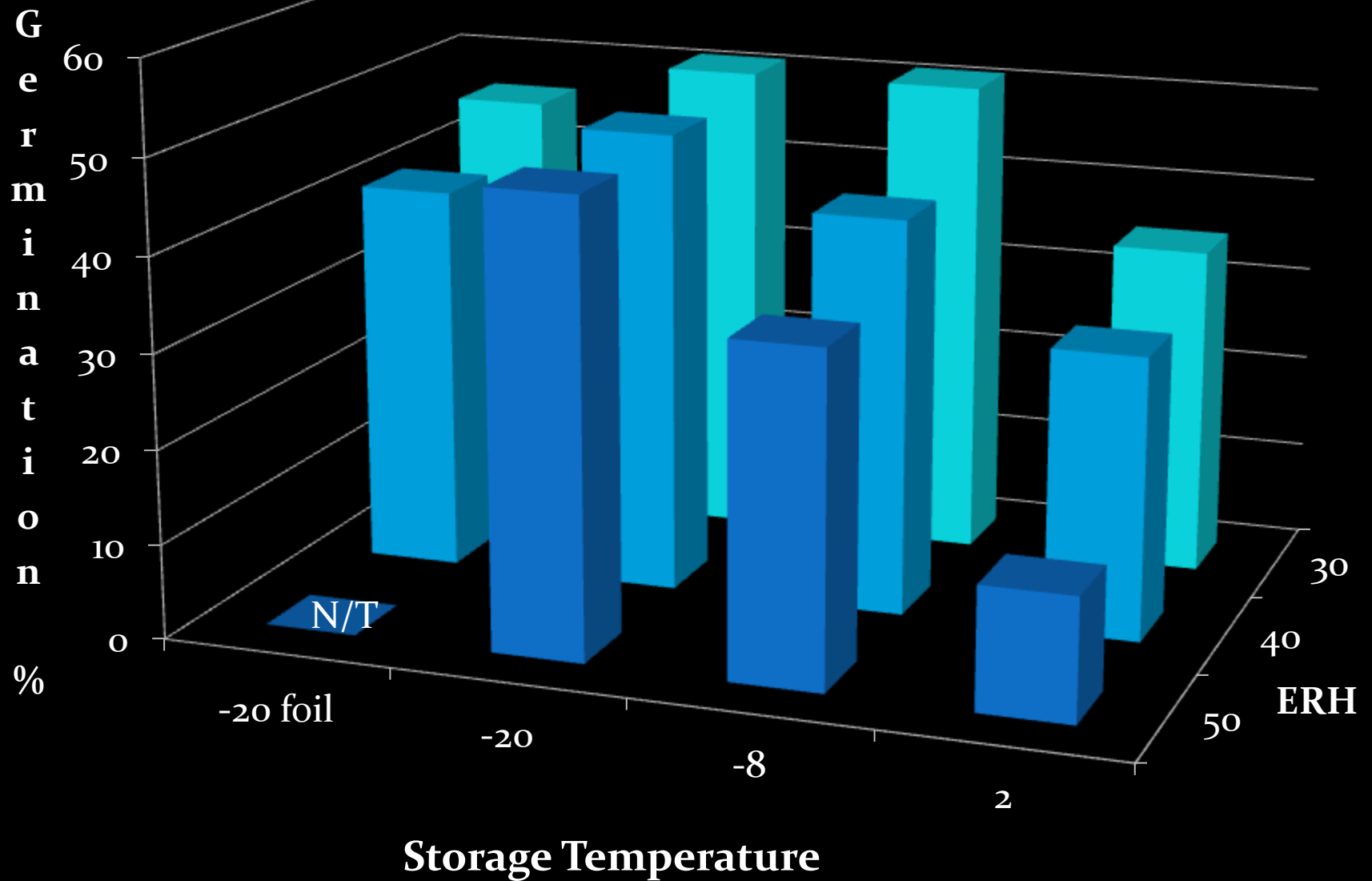
Germination at 29 months, High Purity Seeds, Average of 5 seed lots



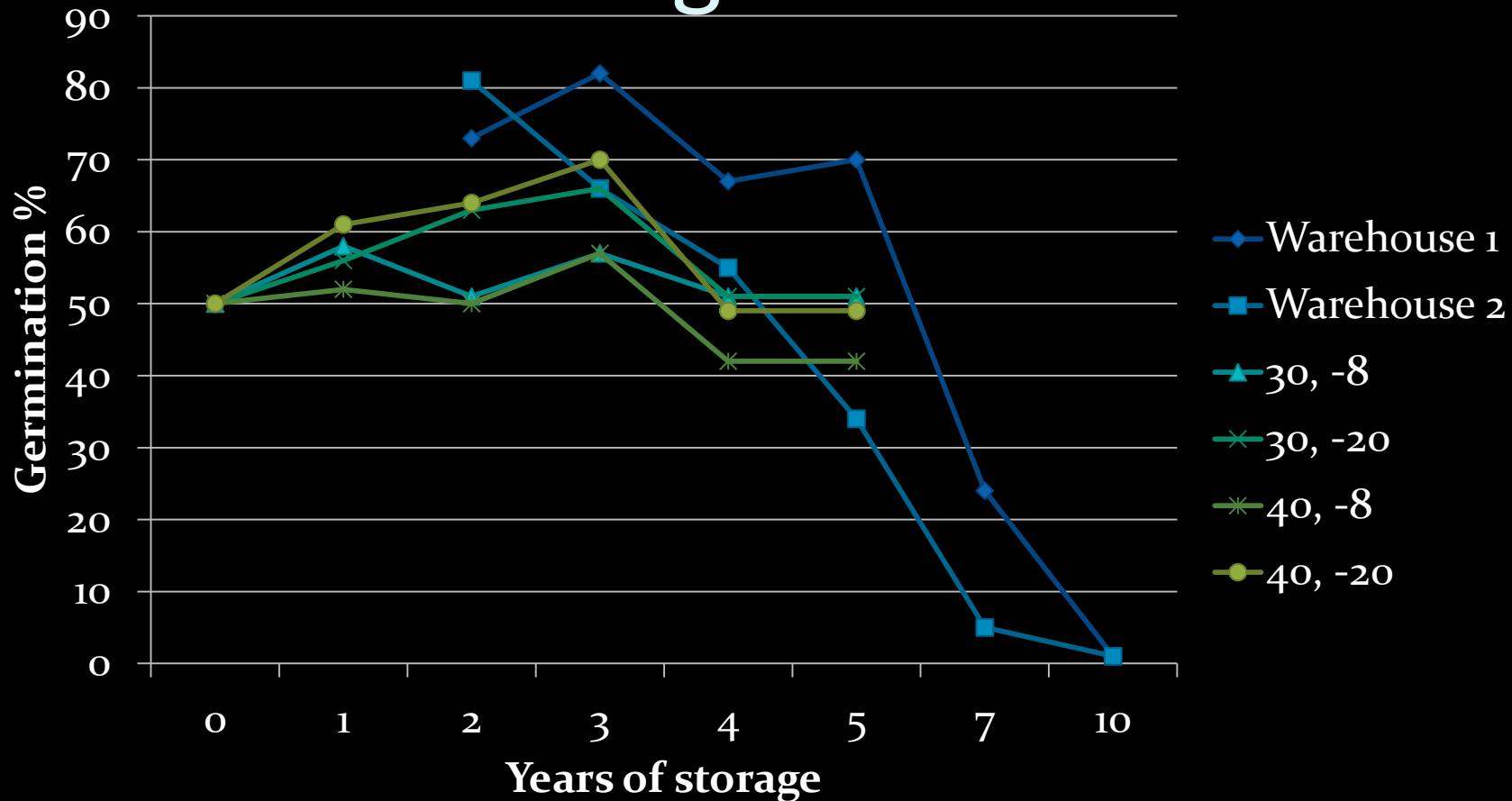
Germination at 41 months,  
Average of 5 seed lots



Germination at 5 years,  
Average of 5 seed lots



# Warehouse Storage vs Sealed Container Storage



# Analysis of Variance on 5 yr Data

- Storage temperature was significant at .05
- Equilibrium Relative Humidity was significant at .10
- Interaction of ERH and storage temperature not significant (not yet anyway)

# Best Sagebrush Seed Storage Practices

(Best to keep germination high)

- Remove trash
- Equilibrate to 30% ERH (works well give margin for accidental increase)
- Seal in moisture proof container (6mil poly worked in this study)
- Freeze the sealed seed packages at between  $-8^{\circ}$  and  $-20^{\circ}$  C



# Future Sagebrush Seed Questions

- How to obtain 100% germination
  - Seed lots did not deteriorate, but why was germ only 50%?
  - Is this a handling problem? A cleaning problem?
  - Higher germination lowers cost of seedlings, reduces seed storage space
- Will seed store as well at 15% to 20% ERH as at 30%?
  - In the arid west, seed might naturally be at 15% ERH – does water have to be added?