A Model System for the Genetic Conservation of Ash (*Fraxinus spp*.)

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UNIVERSITY OF MINNESOTA

Ash loss in native ecosystems

Ash loss in urban ecosystems

Photo courtesy of the City of Toledo, OH

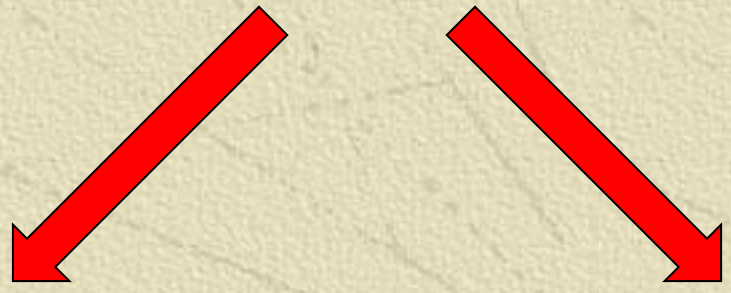
Photo courtesy of the City of Toledo, OH

Save the genetic diversity of ash

Save the genetic diversity of ash

Insecticide injections

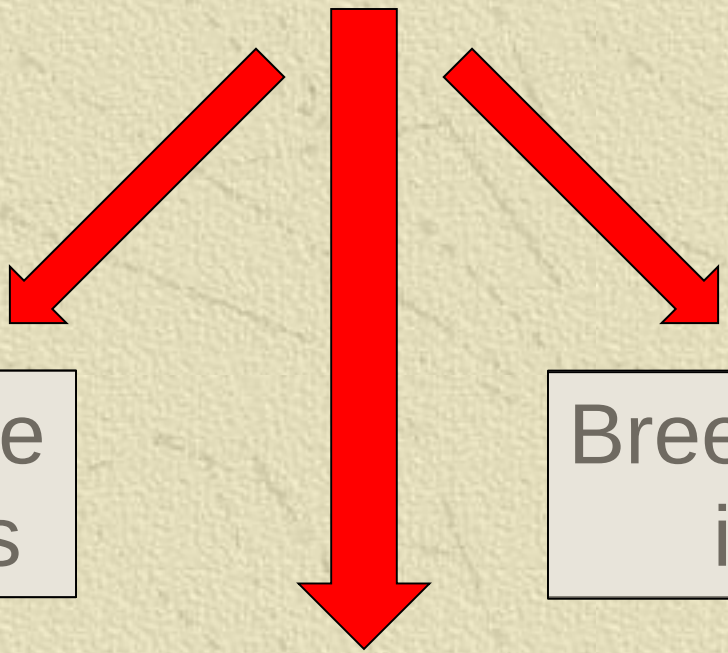
Save the genetic diversity of ash



Insecticide injections

Breed resistance into trees

Save the genetic diversity of ash

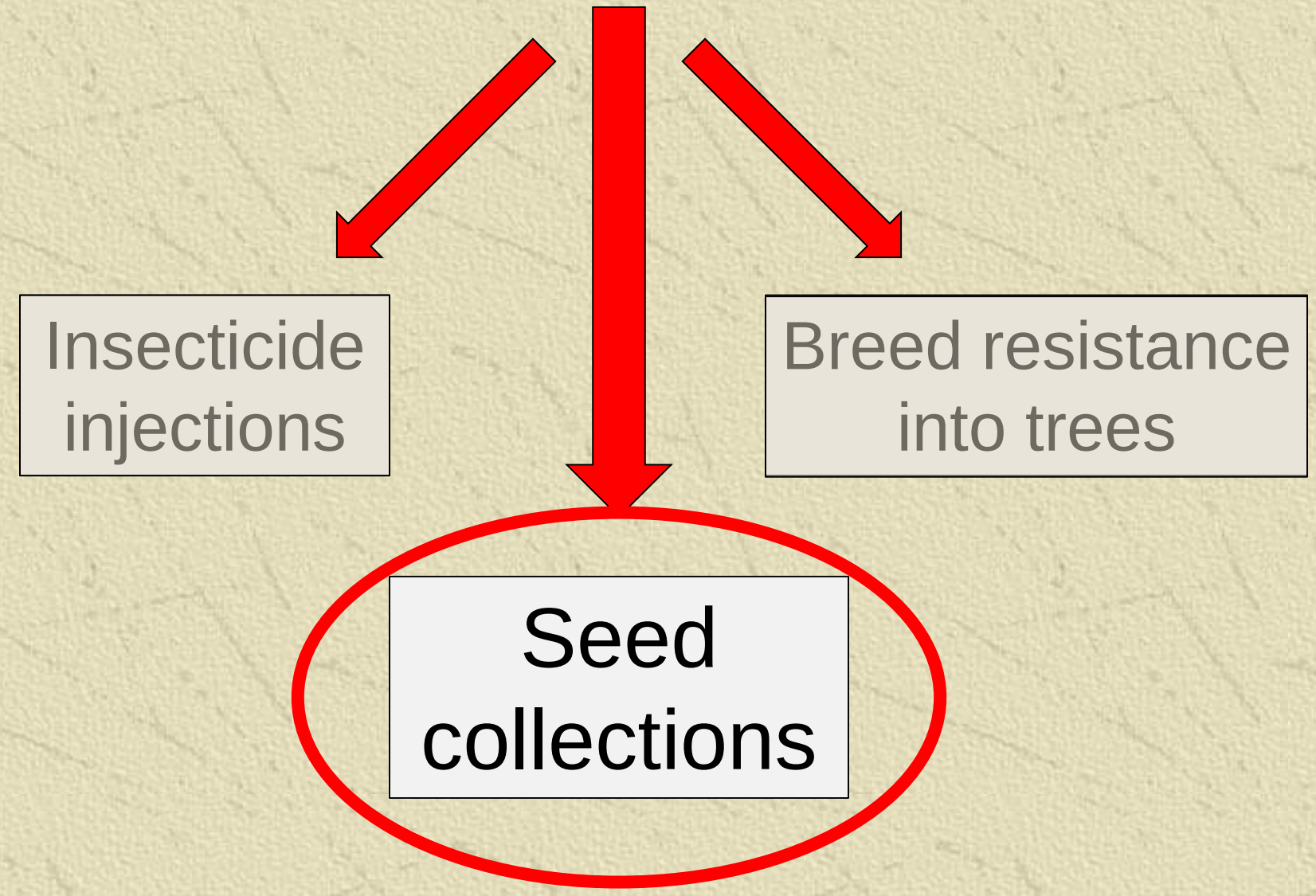


Insecticide injections

Breed resistance into trees

Seed collections

Save the genetic diversity of ash



Save the genetic diversity of ash

3 Goals

1. Physical collections.
2. Basic research into seed collection.
3. Education.

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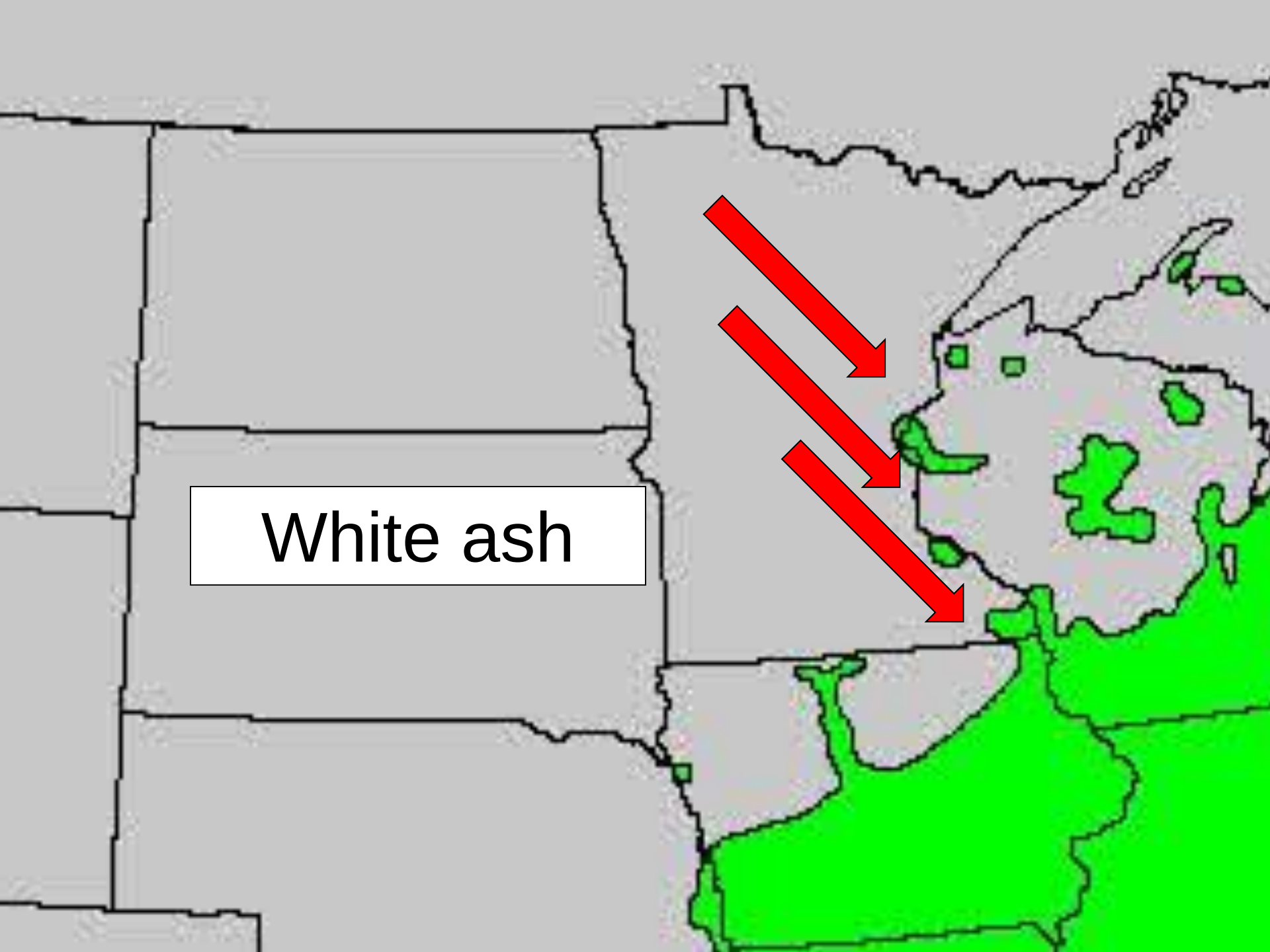

White ash


Black ash


Green ash


MN GA 0063
3.Oct.08
MN GA 0063
3. Oct. 08


MNGA 0055
2.Oct.08
MNGA 0064
3.Oct.08

Seed collections – MN goals

- 8-10 populations across state, each spp.
- ≥ 20 trees per population
- ≥ 50 viable seeds per tree
- Trees separated by ≥ 150’

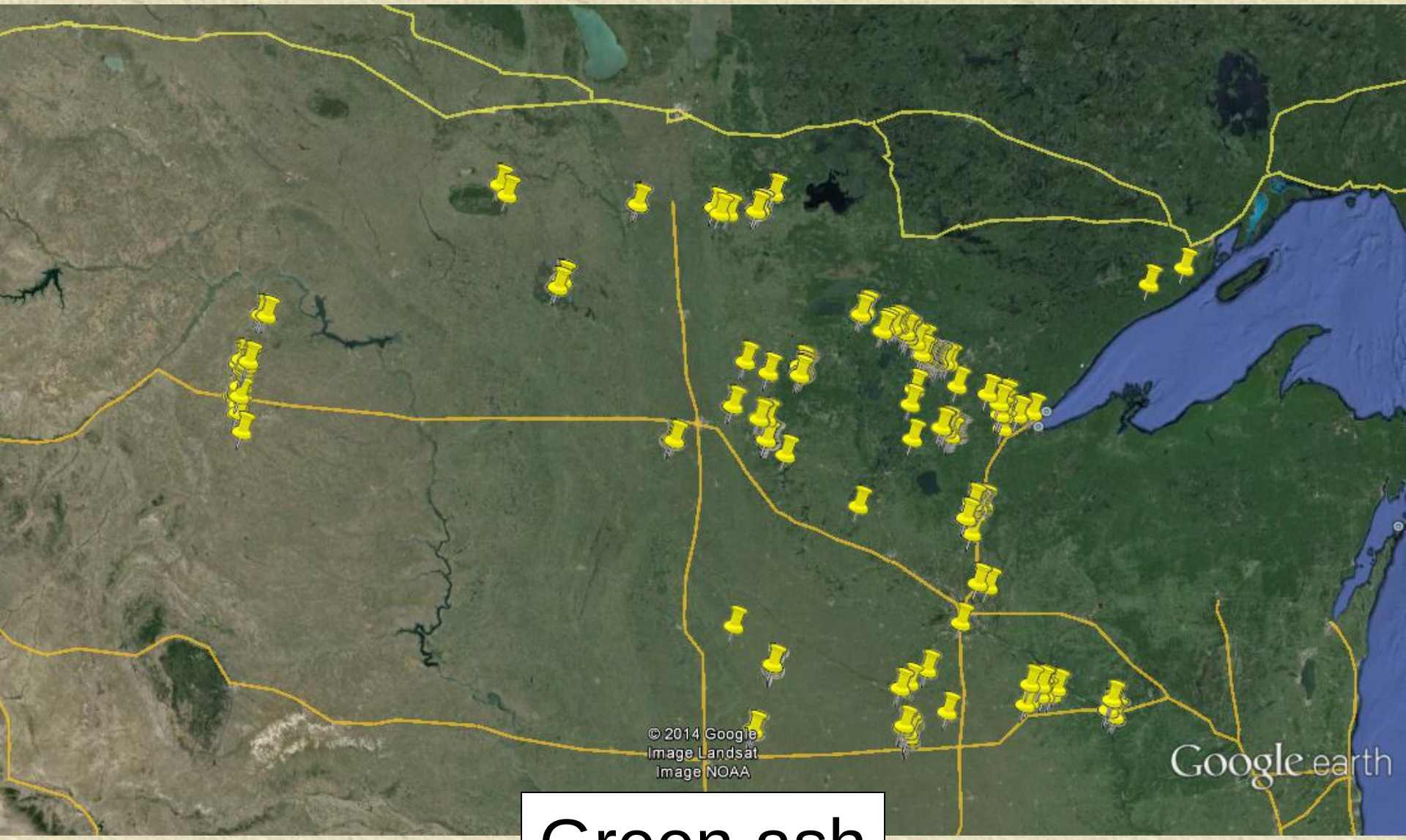
Collections to date

UMN

- 259 black ash
- 422 green ash
- 2 white ash
- 683 trees

NDSU

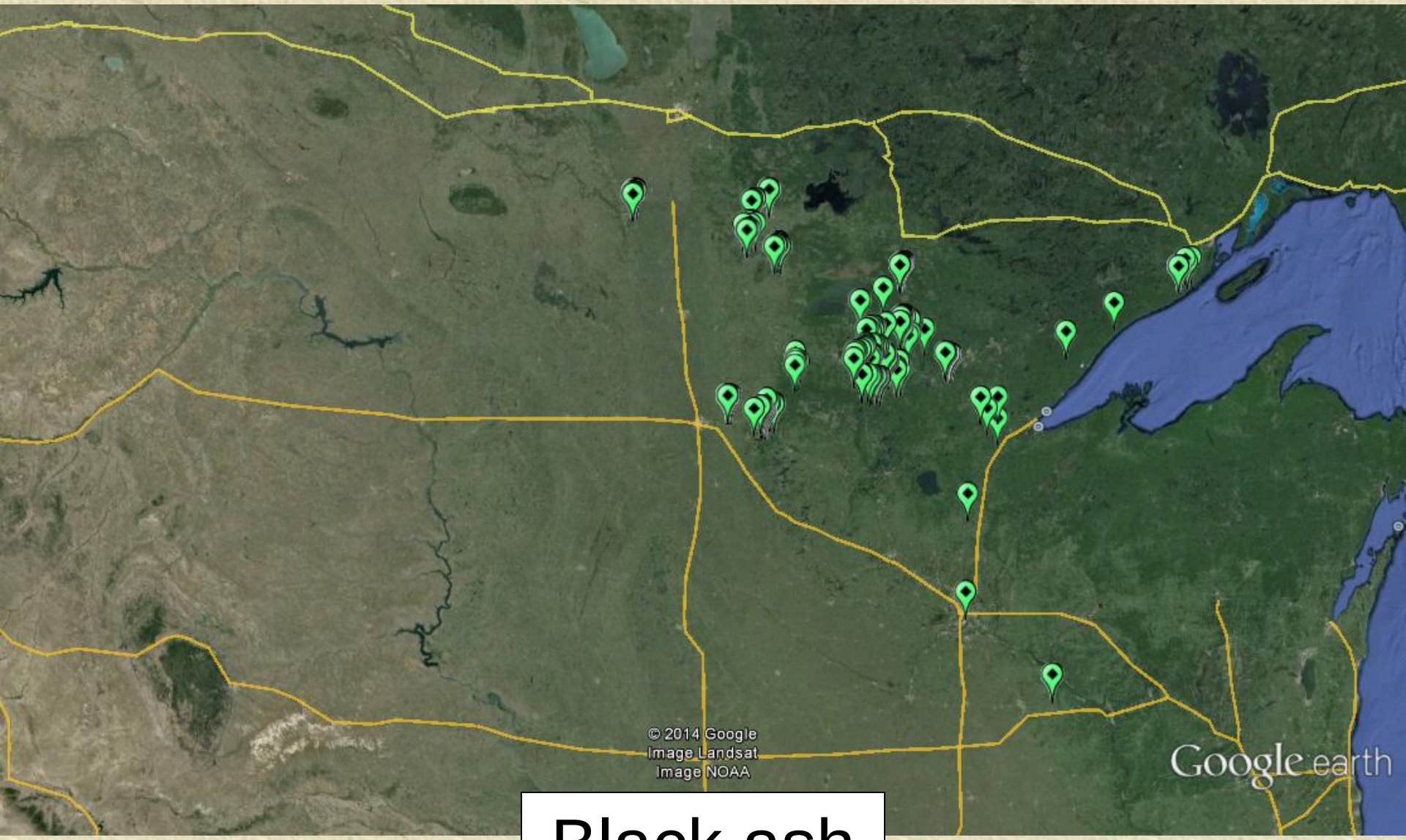
- 131 black ash
- 137 green ash
- 0 white ash
- 268 trees



Green ash

UMN through 2011

NDSU through 2014



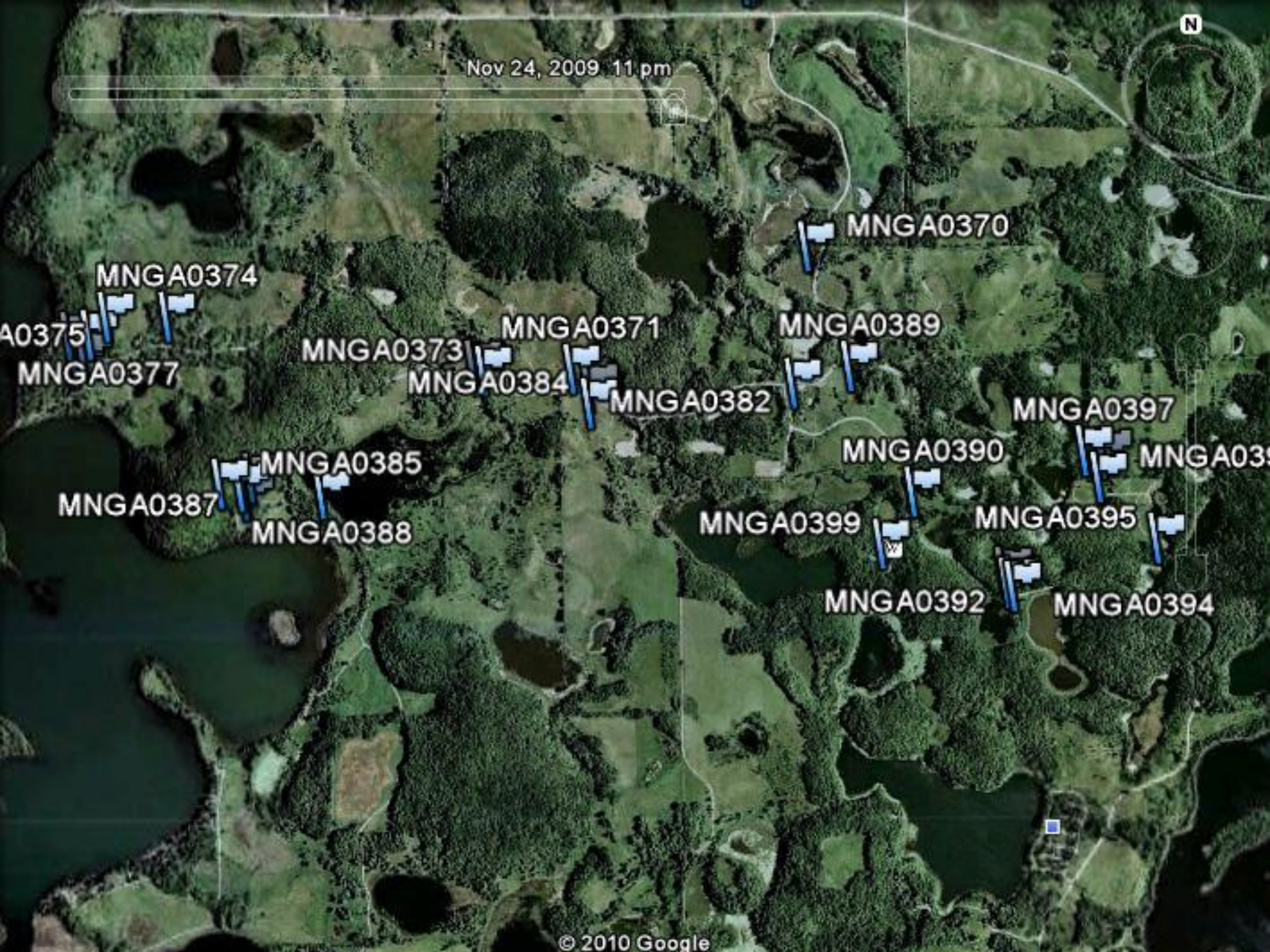
Black ash

UMN through 2011

NDSU through 2014

Pelican Rapids, MN

Luverne, MN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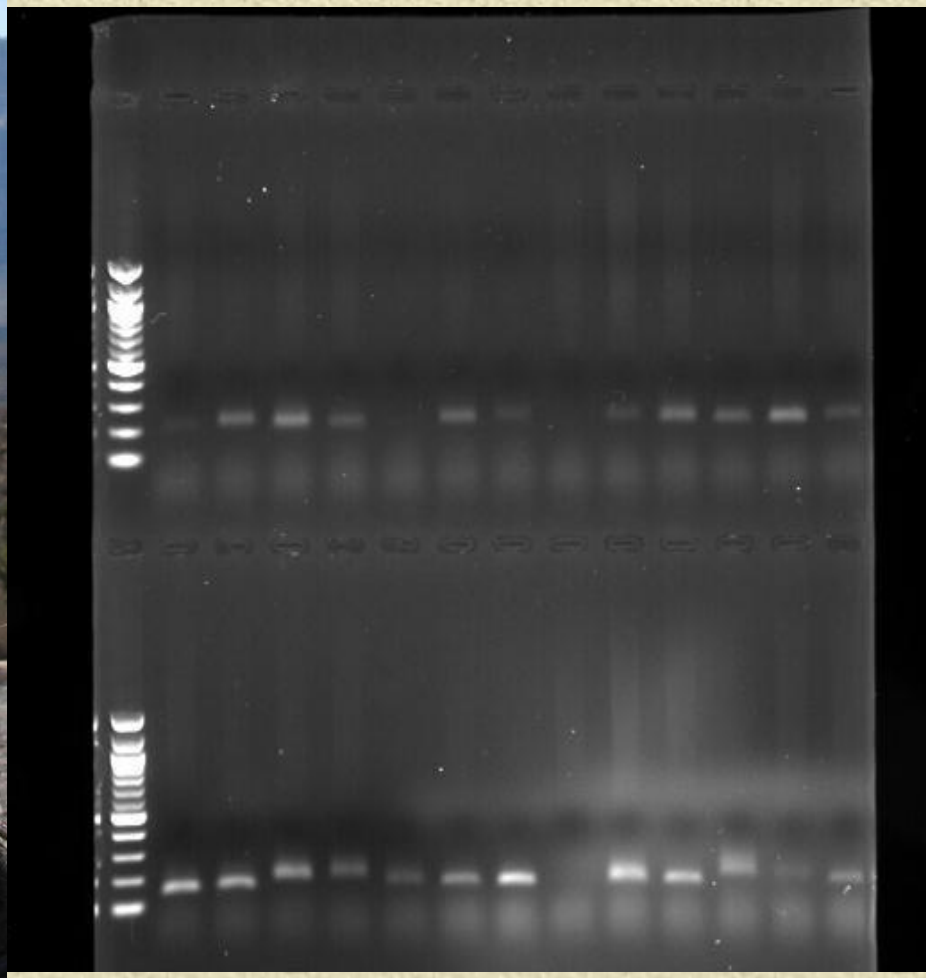

- How much seed needed for 95% of the genetic variation from individual tree?
- Are high and low seed production years different?
- Are microsatellite markers (SSRs) inherited in a Mendelian fashion?

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+/- YES

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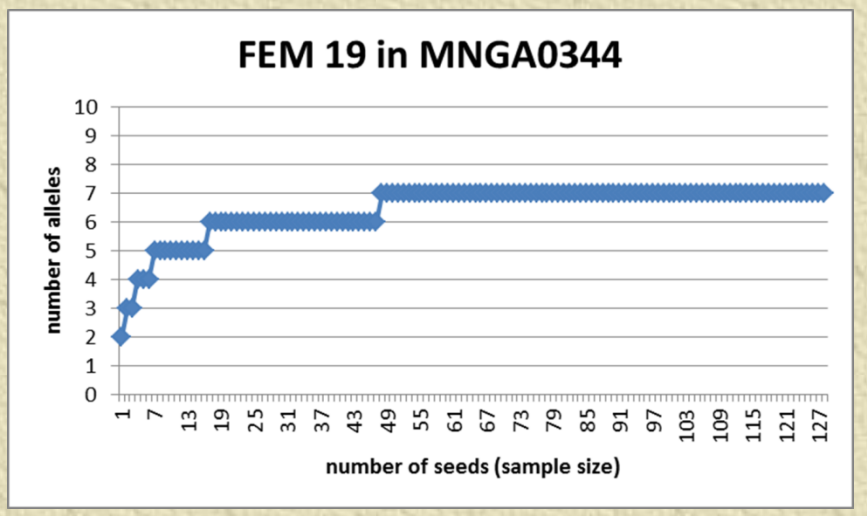
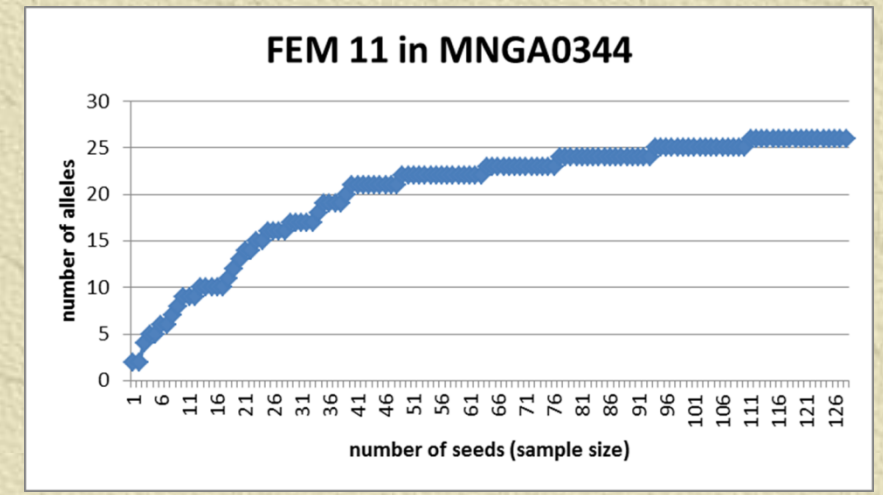
How much genetic variation collected?

$A_o = 7$



- Genetic variation increases with increased number of seeds sampled

$A_o = 26$



- Low variation plateaus sooner

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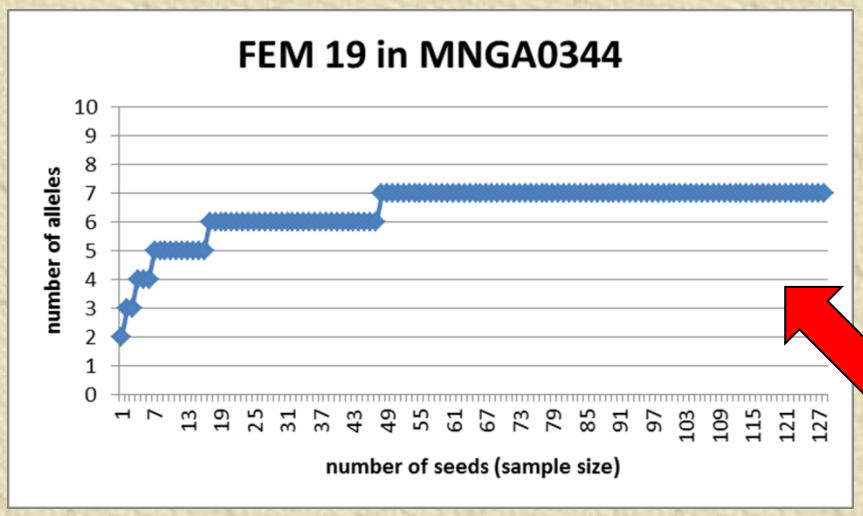

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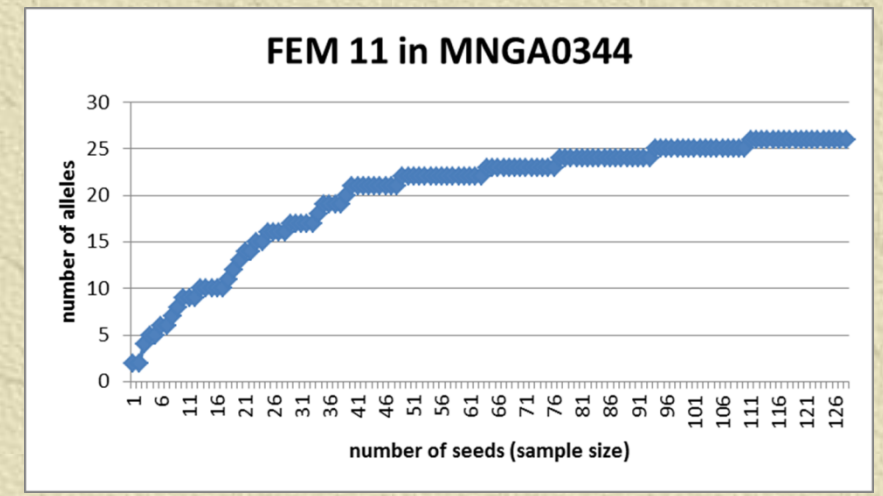

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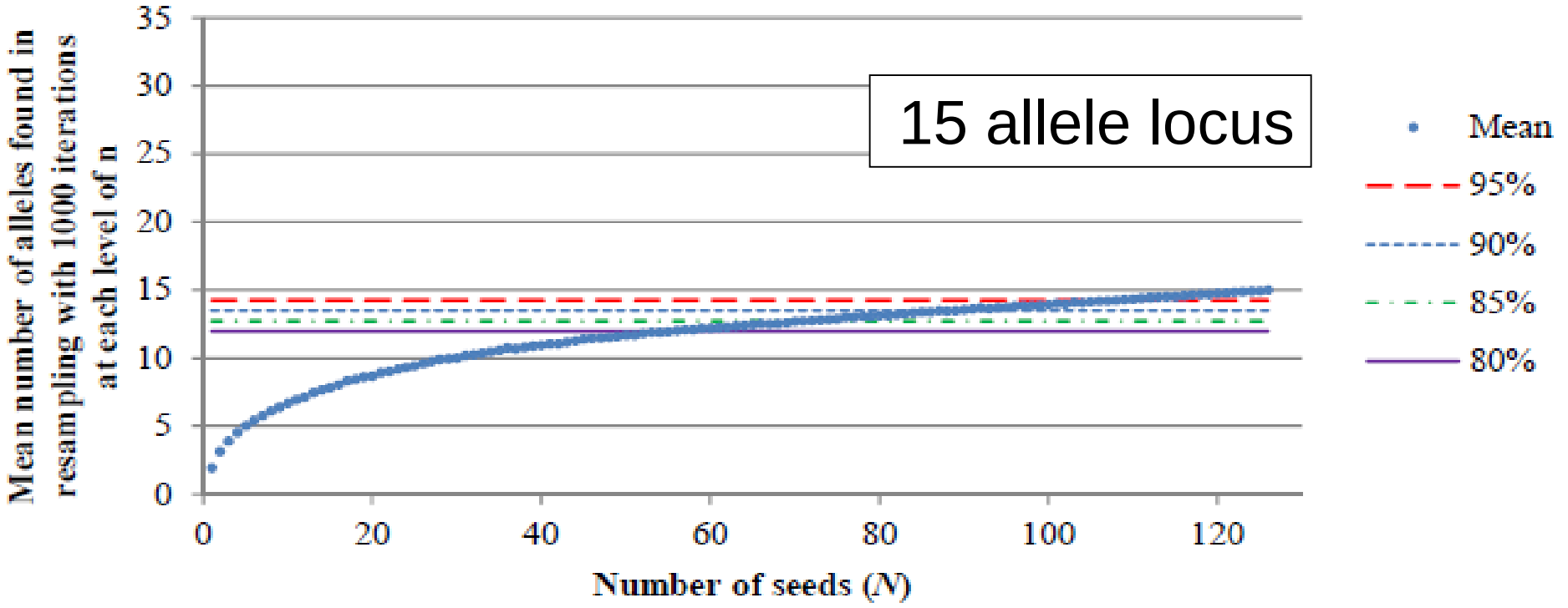
How much seed needed for 95% of the genetic variation from individual tree?



15 allele locus ➔ ~ 105 seeds

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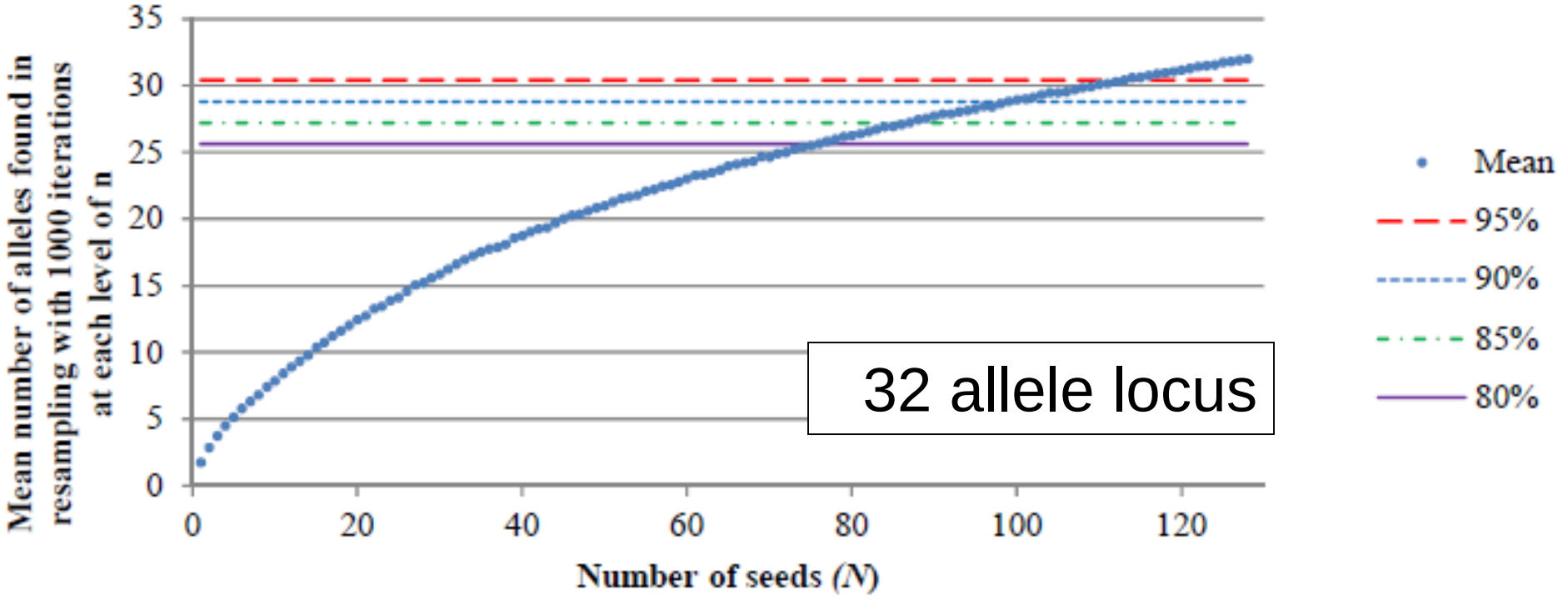

32 allele locus ➔ ~ 115 seeds

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Are high and low seed production years different?

	MNGA0027		MNGA0147		MNGA0143		MNGA0365		MNBA0144		MNBA0007		MNBA0001	
Collection date	Sept 2008	Oct 2011	Oct 2009	Oct 2011	Oct 2009	Oct 2011	Oct 2009	Oct 2011	Sept 2008	Oct 2011	Sept 2008	Sept 2011	Sept 2008	Oct 2011
Seed production year	high	low	high	low	high	low	high	low	high	low	high	low	high	low
N	126	127	126	124	127	127	126	125	127	127	127	127	127	127
Total alleles, all markers	73	64	77	87	67	78	88	79	67	58	53	50	51	42
Mean number of alleles per marker	10.4	9.1	11.0	12.4	9.6	11.1	12.6	11.3	13.4	11.6	10.6	10.0	10.2	8.4
Family mean H_O	0.643	0.590	0.617	0.661	0.665	0.704	0.781	0.783	0.635	0.649	0.613	0.639	0.682	0.723
Family mean H_E	0.582	0.562	0.560	0.583	0.586	0.644	0.671	0.669	0.595	0.601	0.562	0.583	0.564	0.573
Shannon index	3.159	3.057	3.244	3.301	3.155	3.390	3.506	3.460	2.880	2.863	2.803	2.828	2.850	2.744
p-value for t-test	0.492		0.744		0.127		0.774		0.912		0.872		0.426	

- Negligible differences for A_T, and $A_{\overline{X}}$, some are counterintuitive.
- No significant difference in genetic variation (Shannon's Index).

Are high and low seed production years different?

Mostly no.

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Rapid Agriculture Response Fund Projects

- Andrew David – UMN
- Shanelle Dube – Itasca Community College/UMN
- Mike Benedict – BIA
- David Heinzen – MN DNR Resource Assessment
- Julie Hendrickson – UMN
- Egon Humenberger – UMN
- Rick Klevorn – MN DNR Forestry
- Sam Krueger – Itasca Community College
- Mike Reichenbach – UMN Extension
- Keith Webb – Itasca Community College

Ash Seed Collection Instructions:

1. **Tree Identification** – Tree identification is critical to successful seed collection. Ash trees can be identified by leaf, bark, stem, bud and general structure characteristics. Refer to http://forest.nrri.umn.edu/ash for resources on how to identify ash species.

2. **Seed Collection** – Seeds should be collected from a single native wild ash tree and kept separate from other collections. GPS receivers may be used to determine and record the latitude and longitude of specific trees. Be sure to record your map datum on the form if you are using a GPS receiver. (WGS 84 map datum is preferred.)

3. **Harvest Time**- Harvest when the seed is mature in early-autumn. The inner seed coat will be tan and the seed will easily fall from the tree. Fill a large paper grocery bag with 1 to 2" of seed per tree. At a minimum collect at least 2 cups of seed per tree.

4. **Ash Seed Collection Form**. Complete a separate form for each tree. Ship the seed with the form to:

Andrew David
University of Minnesota
North Central Research and Outreach Center
1861 Hwy 169 East
Grand Rapids, MN 55744
adavid@umn.edu
office: 218.327.4521
fax: 218.327.4126

5. **Seed Storage and Shipment** – Place harvested seeds in a paper bag and label the bag to accurately identify the sample. Be sure to label each collection as it is made. Do not store seeds in a plastic bag. Keep seed of each sample in a separate paper bag. Store seed under cool, dry conditions until shipped. Please ship early in the week so the seed does not sit over a weekend.

6. **Questions** contact Mike Reichenbach: reich027@umn.edu or 218-726-6470

Minnesota's Ash Tree Seed Collection Program

Lowland hardwood forest with black ash. Photo courtesy of Michael Benedict

Emerald ash borer, an insect from Asia has been found in Minnesota. This insect kills ash trees of all sizes. The insect has spread rapidly from the Detroit, Michigan area through the movement of ash firewood, ash tree debris, and nursery stock. The loss of all of Minnesota's ash trees is a possibility.

Protecting the genetic resource of ash trees in Minnesota by collecting ash seed from native wild grown trees will provide options for research into resistance and re-establishment. You can help with this effort. For more information visit, http:/forest.nrii.umn.edu/ash

UNIVERSITY OF MINNESOTA
EXTENSION

Ash Seed Collection Form

Accession Number_____

PLANT INFORMATION

Check species enclosed

Black Ash ☐

Green Ash ☐

White Ash ☐

Single tree collection? Yes or No

How collected?

Hand picked ☐

Clipped ☐

Shook onto tarp/catcher ☐

Set out tarp/catcher and returned to later ☐

COLLECTION INFORMATION

Date Collected _____

Collector's Name_____

Collection's Affiliation_____

Address_____

City, State ZIP_____

Phone_____

Email_____

Is this tribal seed? Yes or No

If yes, what tribe? _____

COLLECTION SITE INFORMATION

State_____

County_____

Township_____

Range_____

Latitude_____

Longitude_____

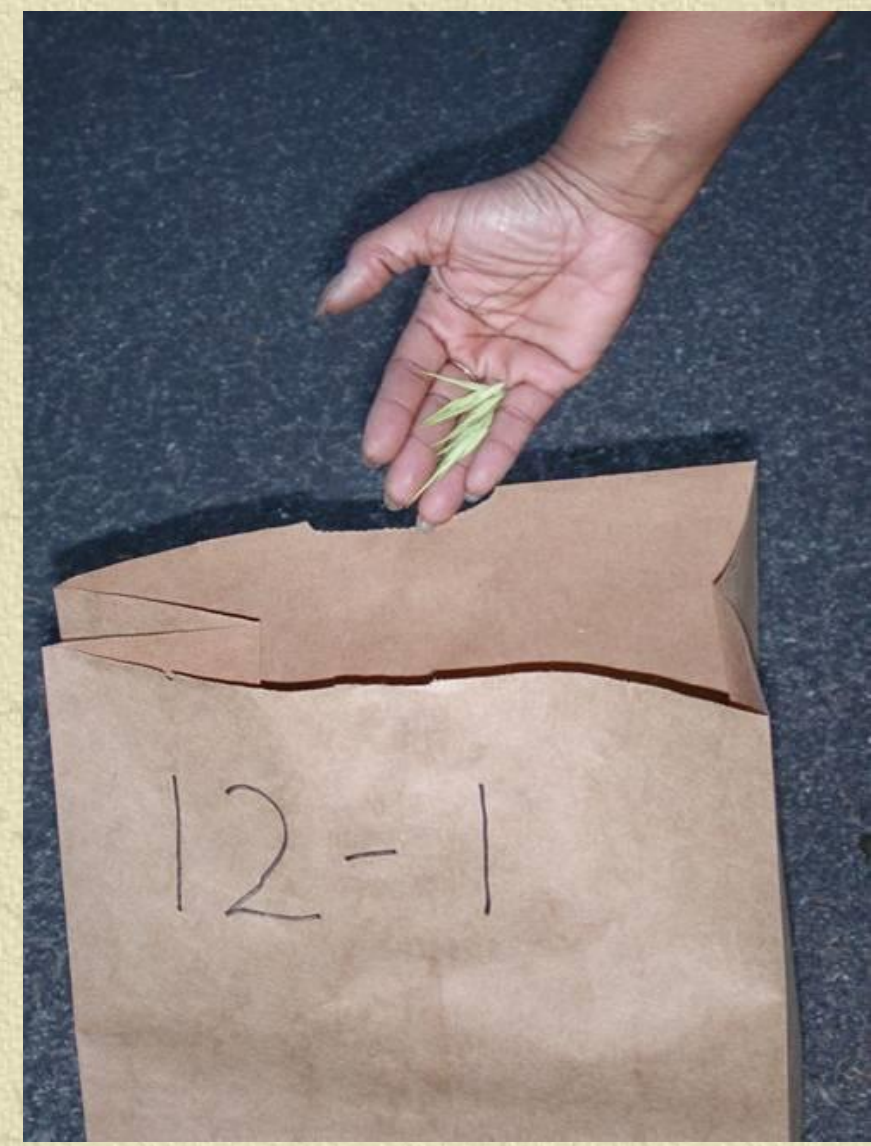
Map Datum_____
(WGS 84 preferred)

Other information about the sample or collection site.

- Please complete this form for each tree
- Enclose the completed form with the seed shipment
- Any questions visit www.ashseed.org or email Mike Reichenbach, reich027@umn.edu.

Volunteer collections

- Sources – families, boy scouts, individuals, farmers
- Not reliable (< 2% of collections)
- Primarily single tree collections



Student collections

- Special-topics course – NDSU
- Real-world conservation
- Students collect, process and submit samples

Student collections

- Experiential learning
- Genetic analysis – not available
- Collaborations, mapping and communication emphasized

Student collections

- Distance learning technology
- Timing – fall semester …
- Travel – a cost, and a challenge with time

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Questions?

School of Natural Resource Sciences
Soil Science
Natural Resources Management
Range Science
Entomology
North Dakota State University

Department of FOREST RESOURCES
University of Minnesota