NW Referee

Effect of storage conditions on seed viability and vigor of fine fescue

Objective

Determine the effect of storing coated and non-coated creeping and chewing fescues in three environments on seed viability and vigor

Referee outline

- A protocol prepared and sent to five participant labs.
- Seeds were coated in Summit Inc., Idaho.
- Sub-samples for all labs were prepared in Pennington seed lab, MO.
- Not all labs are conducting AAT or cold tests.
- Data are collected and analyzed at OSU seed lab.

Expected outcome

Determine level the deterioration (if any) in seed quality of coated vs. non-coated seeds of fine fescue over a period of two years when stored at 3 environments.

Summary

- Choose seed lots and treat the seeds.
- Identify storage environments.
- Identify interested labs.
- create sub samples from each treatment and send them to the labs.
- Conduct the tests and collect results.
- Analyze data.
- Publish the results.

Rationale

- **Creeping and chewing fescue are important turf crops in the US.**
- **Stop sales and difficulty in identifying the true value of carry over seeds in warehouses and home improvement stores have become a problem.**
- **The study will shed light on how to monitor seed quality of fine fescues in storage and identify the proper safe storage conditions.**
- **No published reports are available on the potential storability of coated and non coated seed of fine fescues.**

Materials and Methods

Seed Materials

- Two creeping red *fescue* *(Festuca rubra L. spp. rubra)*, Lastrous and Razor.
- Two chewing fescue *[Festuca rubra spp. fallax (Thuill.)]*, ACF 266 and 7 seas.
- All seed lot were harvested 2010, and had different initial qualities.
- Coated and non-coated seeds of each lot were used. Seed coating materials are based on starch polymers.

Length of the study

Two years, with seed evaluation conducted each 6 months.

- April 2011 (initial testing) — Oct 2011 (6 mo.)
- April 2012 (1 year) — Oct 2012 (18 mo.)
- April 2013 (2 years)

- Five Labs are participating in the study: CA, WA, Pennington MO, Turf Tech, and OSU Seed Lab.

Storage conditions

- Normal warehouse conditions in SW MO.
- Garden Center at home improvement center, Springfield, MO.
- Constant 10ºC.

Temperature and RH collected monthly in each storage environment.

Tests conducted each 6-month

- **Seed moisture content: (AOSA Seed Moisture determination HB).**
- **TZ Test: (AOSA Tetrazolium HB).**
- **Standard germination test: (AOSA Rules). Pre-chill at 10ºC for 7d, 0.2% KNO_3, and transfer to 15-25ºC for 21d.**
- **Speed of germination index: calculated based on weekly counts of the germination test.**
- **Cold test: (AOSA Seed Vigor Testing HB). Incubate at 5ºC for 7d. (in soil), transfer to 15-25ºC, and final count after 14d.**
- **Accelerating aging test: (AOSA SVT HB). 72h at 41ºC, then germination at 15-25ºC for 14d.**

Storage Temperatures and Relative humidity

Storage	S.W. MO Warehouse		Garden Center		10˚ C	
Date	Temp˚ C	RH %	Temp˚ C	RH%	Temp˚ C	RH%
Apr-11	20	35	23	31	12	30
May-11	23	**62**	21	39	13	34
Jun-11	22	**65**	22	50	12	30
Jul-11	**30**	38	23	44	10	32
Aug-11	**32**	41	24	42	10	31
Sep-11	**28**	42	23	40	11	30
Oct-11	21	**64**	22	50	10	32
Nov-11	20	38	21	40	12	32
Dec-11	5	46	20	47	12	31
Jan-12	2	28	20	45	10	30
Feb-12	0	30	21	44	13	32
Mar-12	24	52	22	49	12	30
Apr-12	20	38	22	51	11	30
Average	**19**	**45**	**22**	**44**	**11**	**31**
Max	**32**	**65**	**24**	**51**	**13**	**34**
Min	**0**	**28**	**20**	**31**	**10**	**30**

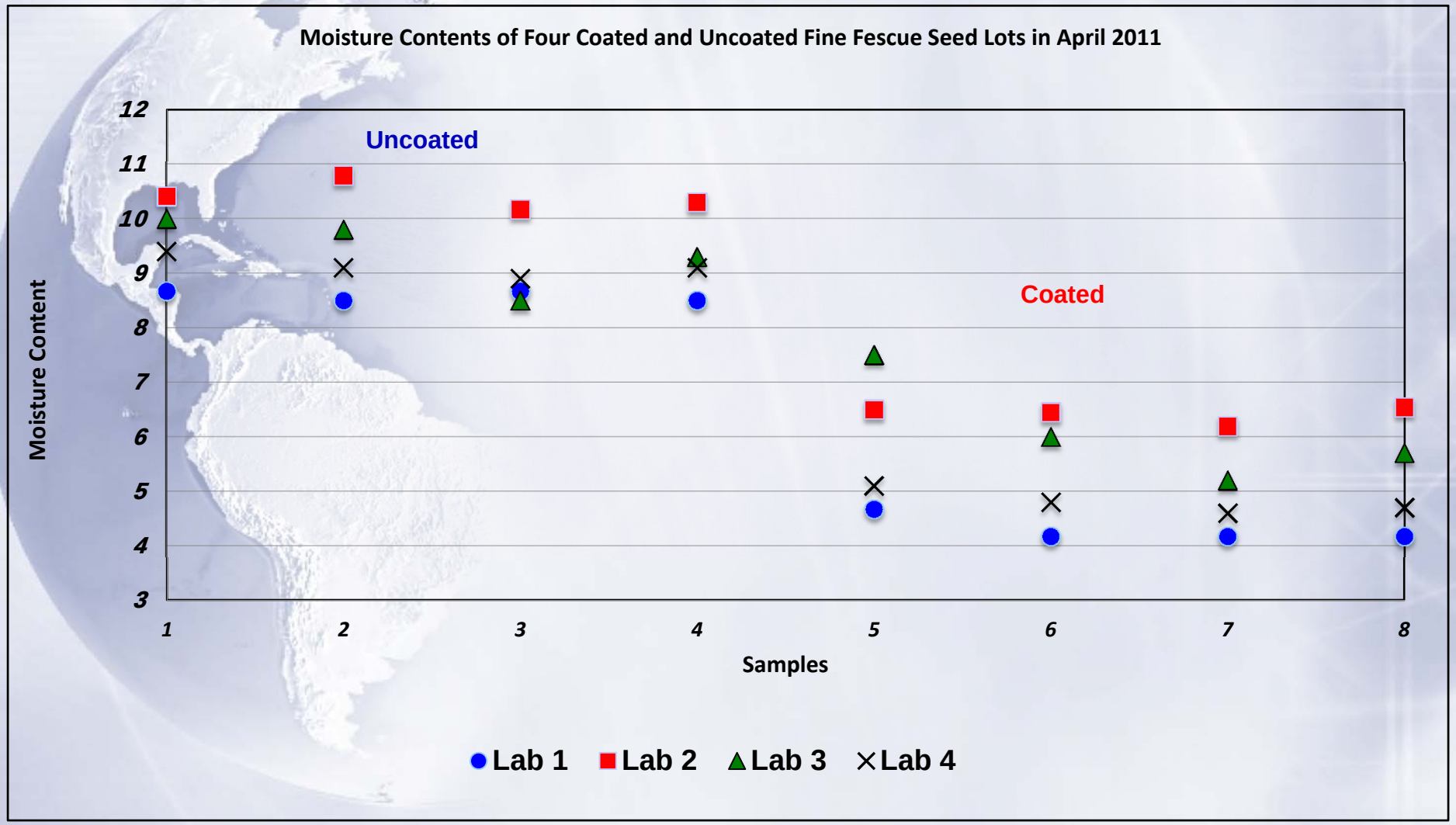
Table 1: ANOVA for measuring seed quality of coated and non-coated seeds of four fine fescue seed lots in April 2011 using standard germination, TZ, speed of germination index, cold test, AAT and seed moisture Content.

Source of variation	Probability (0.05)					
	Standard Germ	TZ	Speed of Germ†	Cold Test	AAT	MC
Treatment (T)	ns	ns	0.03*	ns	0.000***	0.000 ***
Crops (C)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
(T) x (C)	ns	ns	ns	ns	ns	ns
Varieties (V)	0.000***	0.000***	0.000***	0.000***	0.000***	ns
(T) x (V)	ns	0.03*	ns	ns	ns	0.000***
Labs (L)	0.000***	0.000***	ns	0.000***	0.000***	0.000***
(T) x (L)	0.04*	ns	ns	ns	0.000***	0.000***
T x C x V x L	0.04*	ns	ns	ns	ns	0.04*

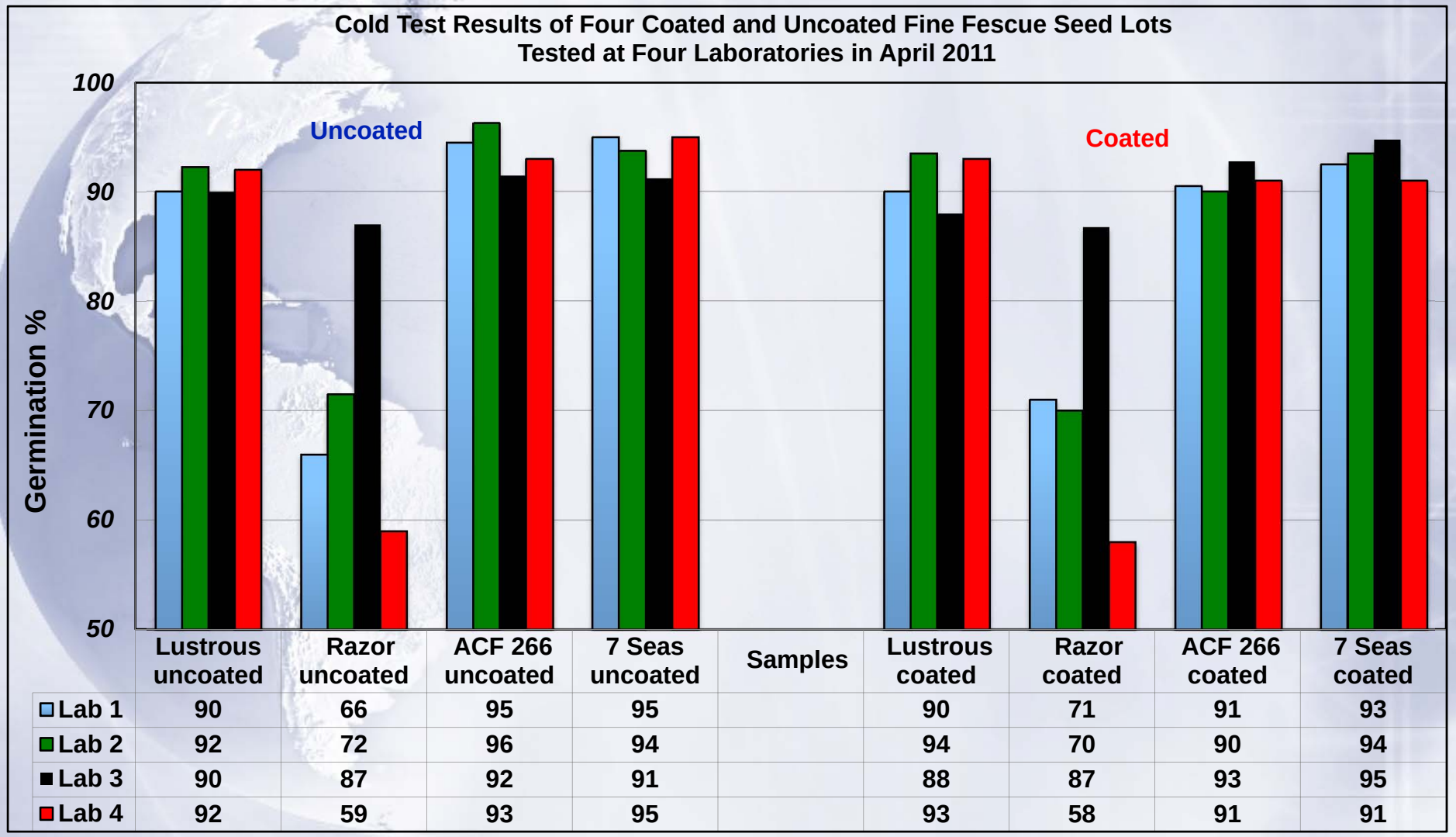
Table 2: ANOVA for measuring seed quality of coated and non-coated seeds of four fine fescue seed lots stored in three environments using standard germination, TZ, speed of germination index, cold test, AAT and seed moisture Content (Oct 2011).

Source of variation	Probability (0.05)					
	Standard Germ	TZ	SGI	Cold Test	AAT	MC
Treatment (T)	0.000***	0.05*	0.000***	0.000***	0.02*	0.000***
Varieties (V)	0.000***	0.000***	0.000***	0.000***	0.000***	0.01**
(T) x (V)	0.000***	ns	0.000***	0.000***	0.000***	ns
Environments (E)	0.000***	0.000***	0.000***	ns	0.000***	0.000***
(T) x (E)	0.000***	ns	0.02*	ns	ns	ns
Labs (L)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
(T) x (L)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
T x V x E x L	0.000***	0.000***	0.000***	0.000***	ns	0.01**

Results - Moisture Contents - April 2011

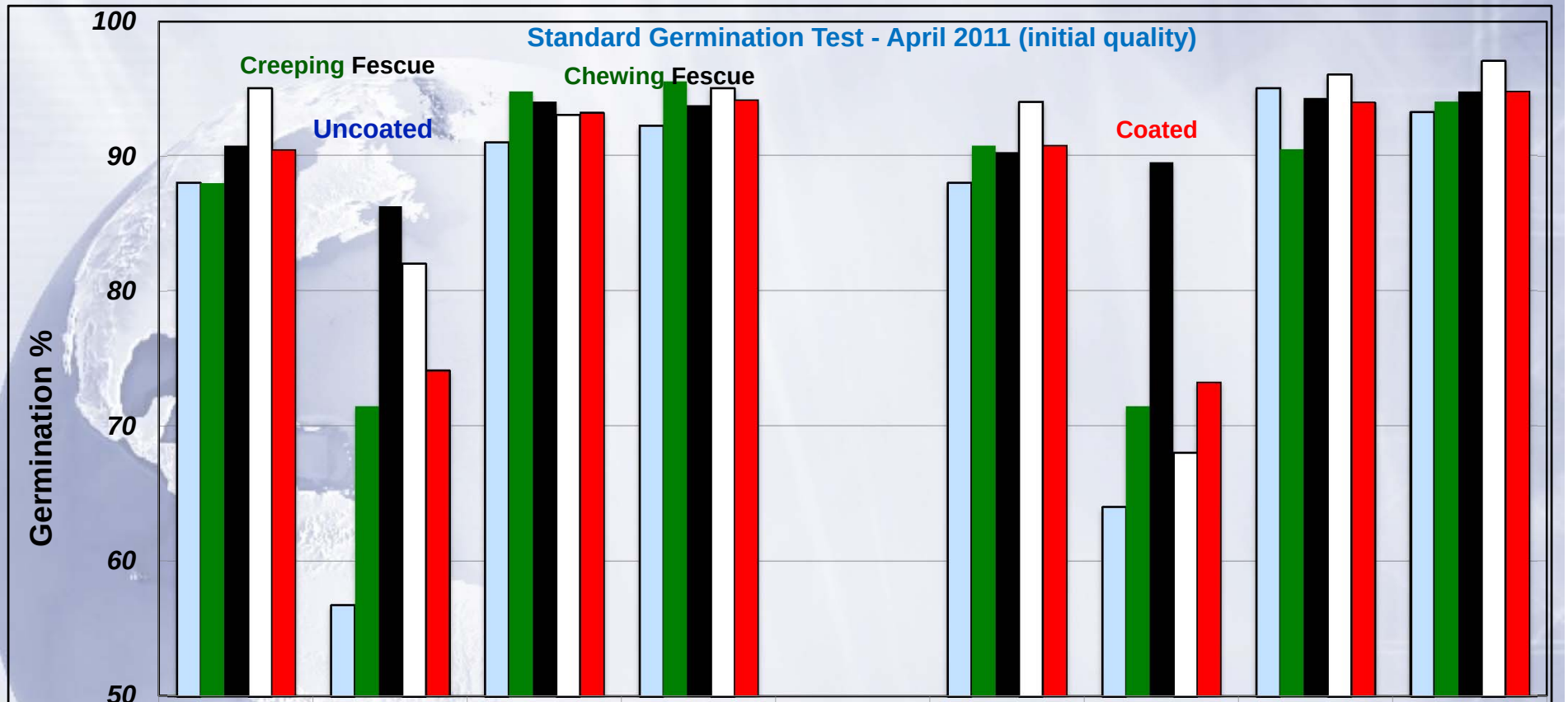


Results - Tetrazolium Test - April 2011



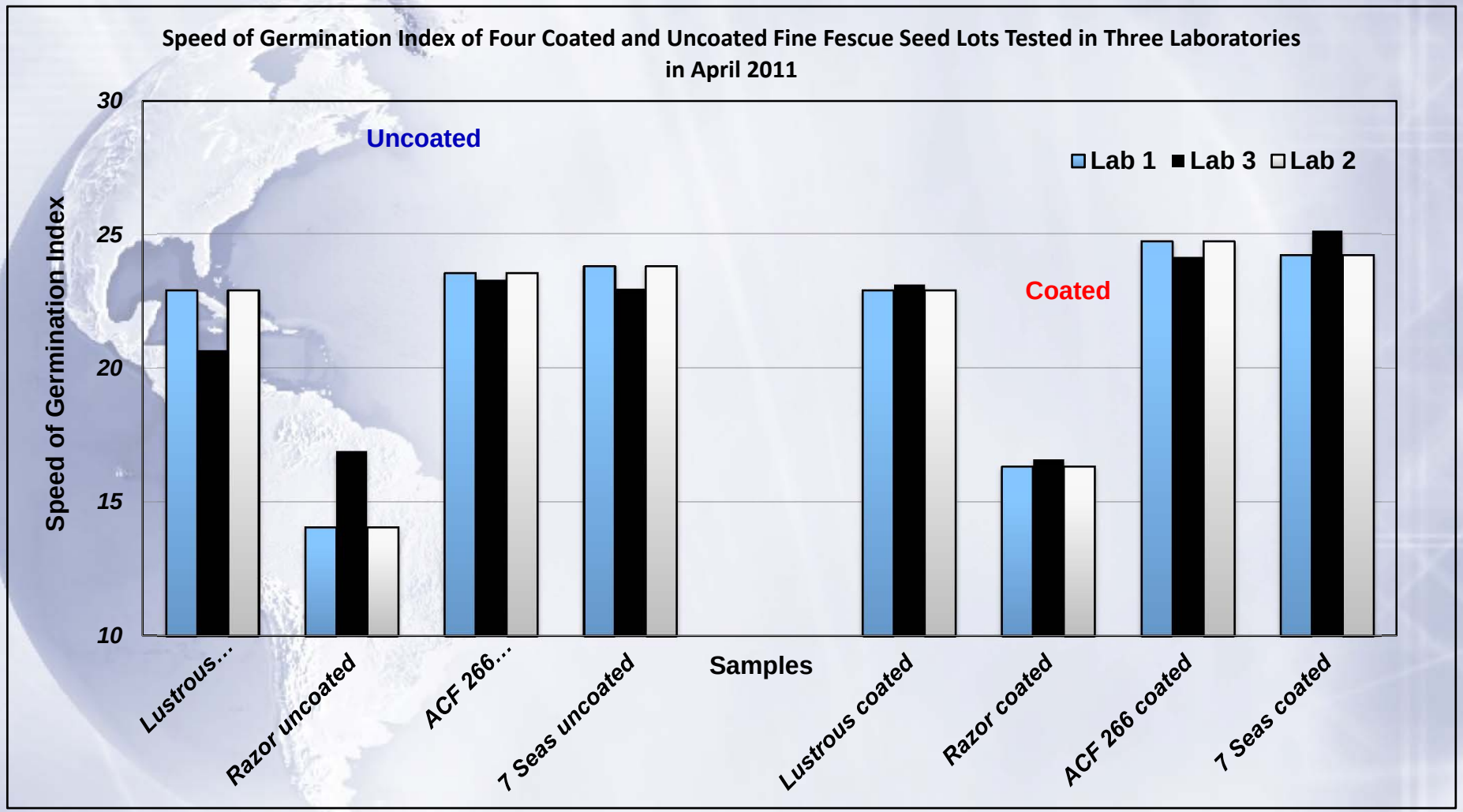
	Lustrous uncoated	Razor uncoated	ACF 266 uncoated	7 Seas uncoated	Samples	Lustrous coated	Razor coated	ACF 266 coated	7 Seas coated
Lab 1	90	66	95	95		90	71	91	93
Lab 2	92	72	96	94		94	70	90	94
Lab 3	90	87	92	91		88	87	93	95
Lab 4	92	59	93	95		93	58	91	91

Results - Initial quality (SGT) before storing seeds - April 2011

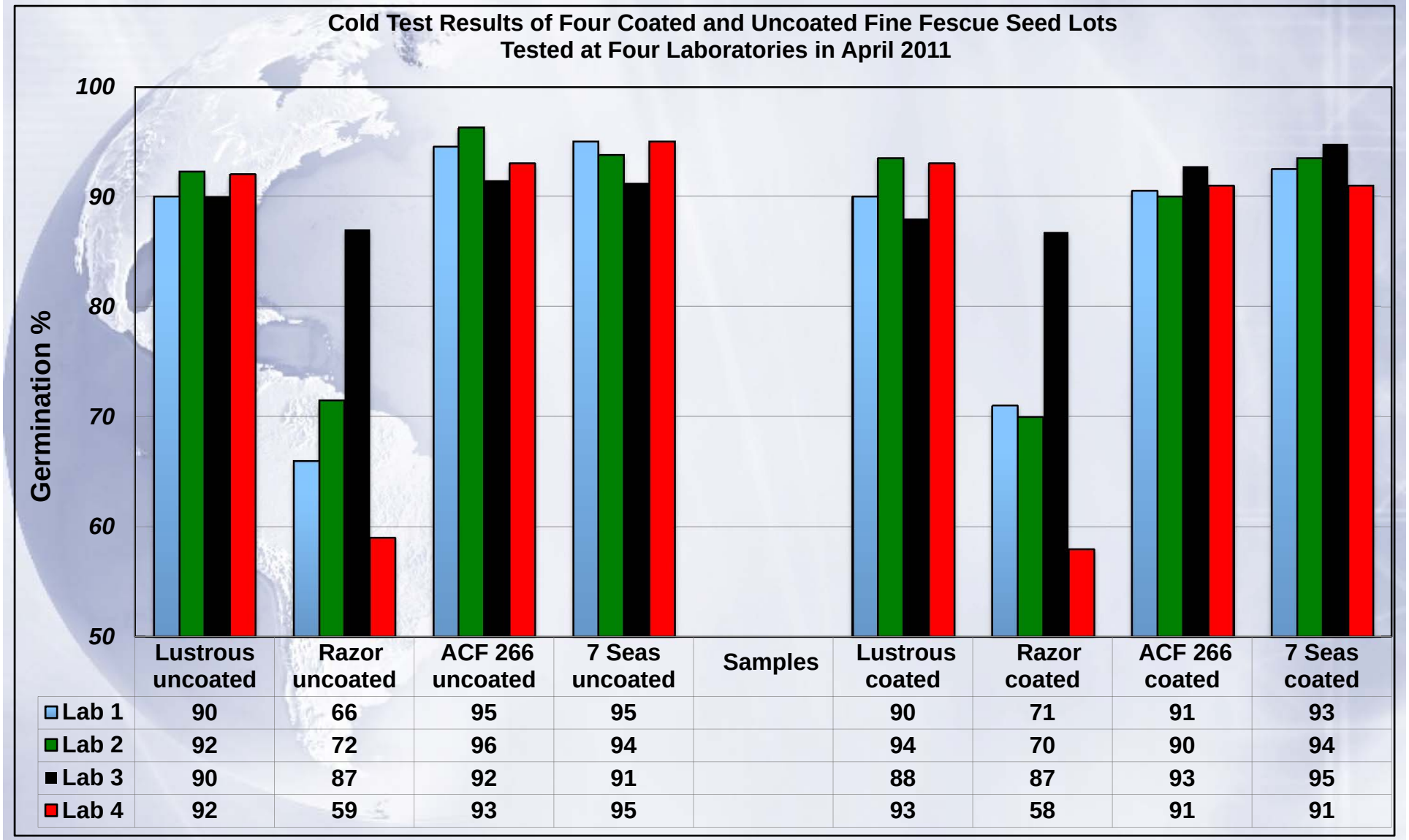


	Lustrous uncoated	Razor uncoated	ACF 266 uncoated	7 Seas uncoated	Samples	Lustrous coated	Razor coated	ACF 266 coated	7 Seas coated
Lab 1	88	57	91	92		88	64	95	93
Lab 2	88	72	95	96		91	72	91	94
Lab 3	91	86	94	94		90	90	94	95
Lab 4	95	82	93	95		94	68	96	97
Lab 5	90	74	93	94		91	73	94	95

Results - Speed of Germination Index - April 2011

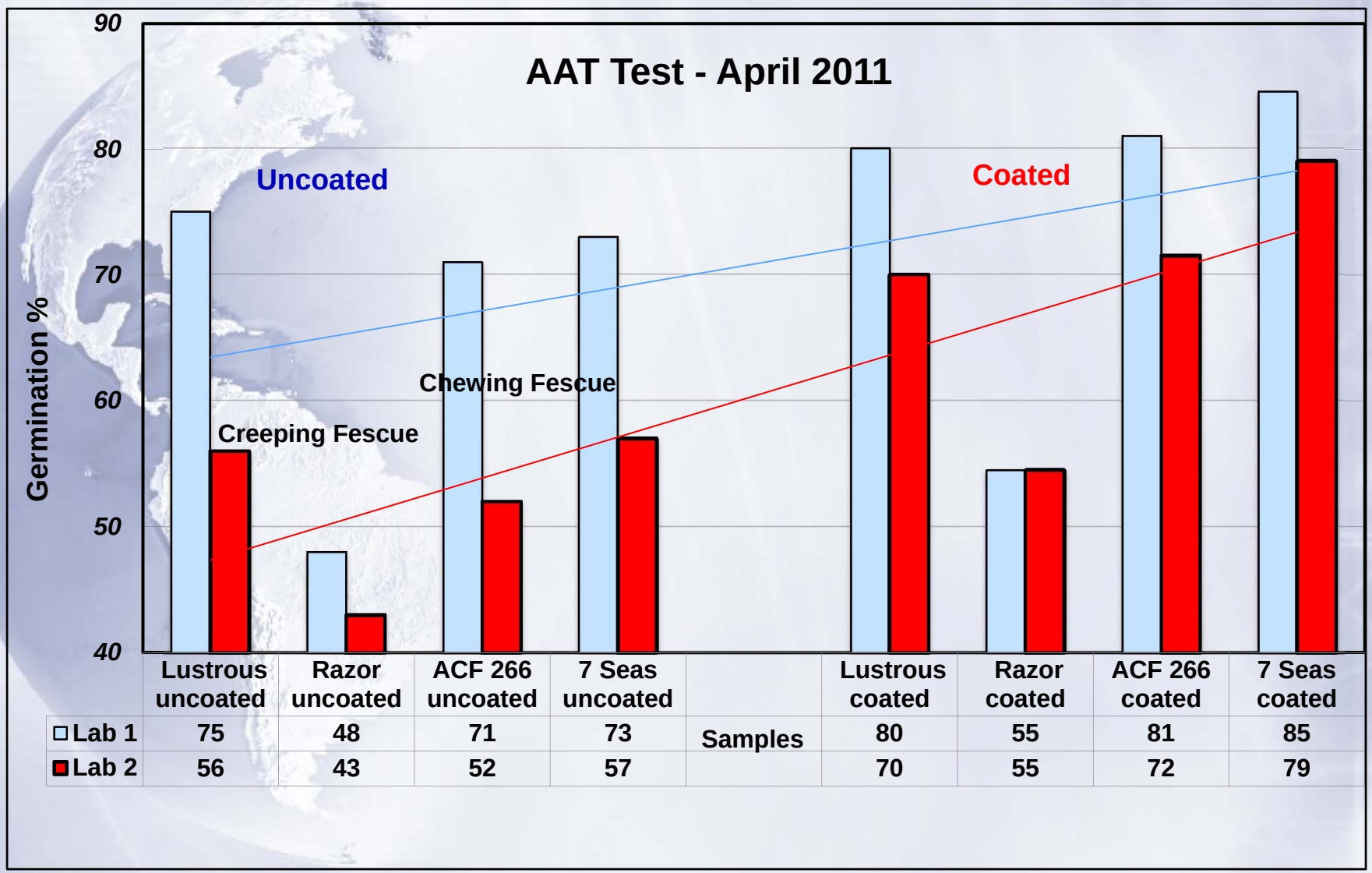


Results - Cold Test - April 2011



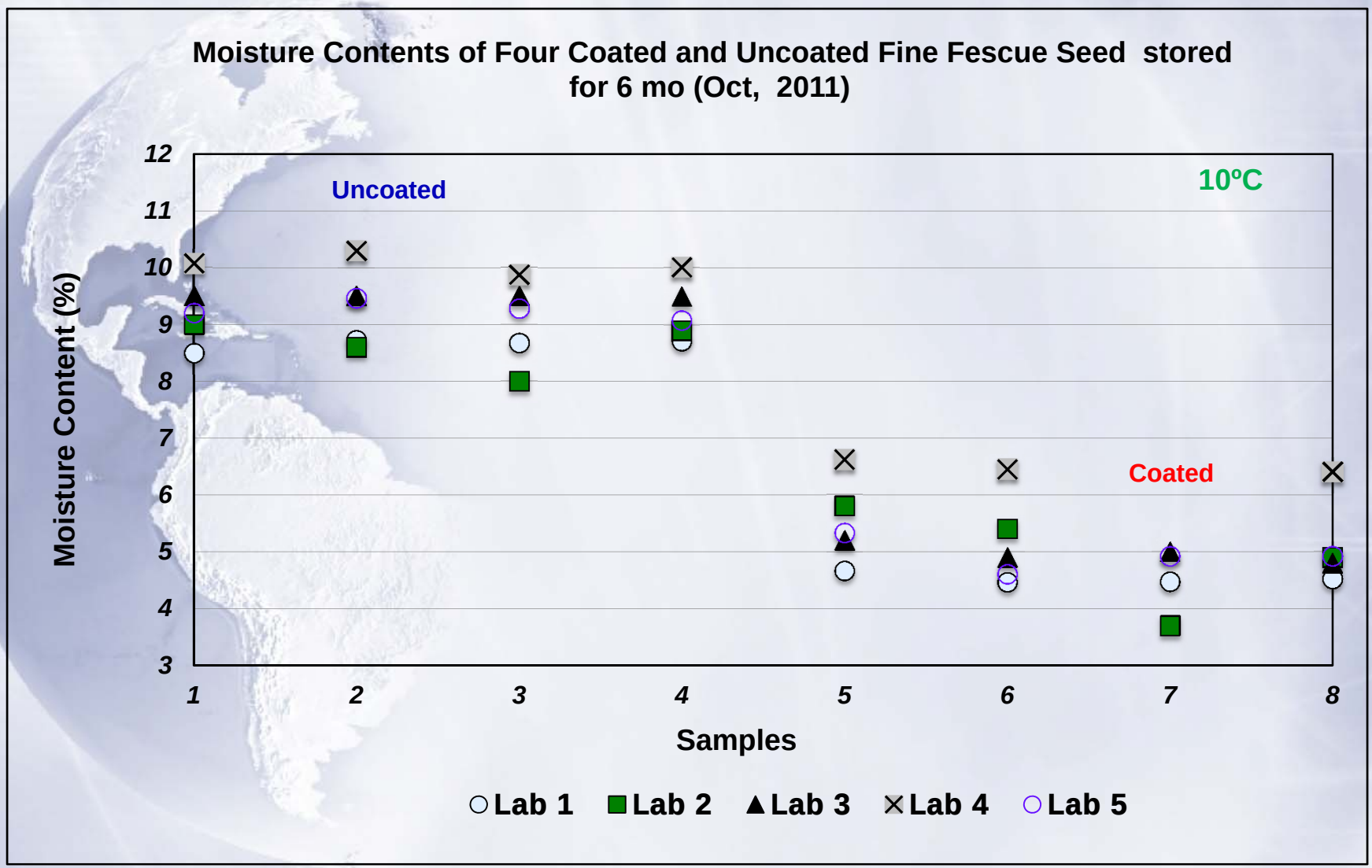
	Lustrous uncoated	Razor uncoated	ACF 266 uncoated	7 Seas uncoated	Samples	Lustrous coated	Razor coated	ACF 266 coated	7 Seas coated
Lab 1	90	66	95	95		90	71	91	93
Lab 2	92	72	96	94		94	70	90	94
Lab 3	90	87	92	91		88	87	93	95
Lab 4	92	59	93	95		93	58	91	91

Results - AAT Test - April 2011

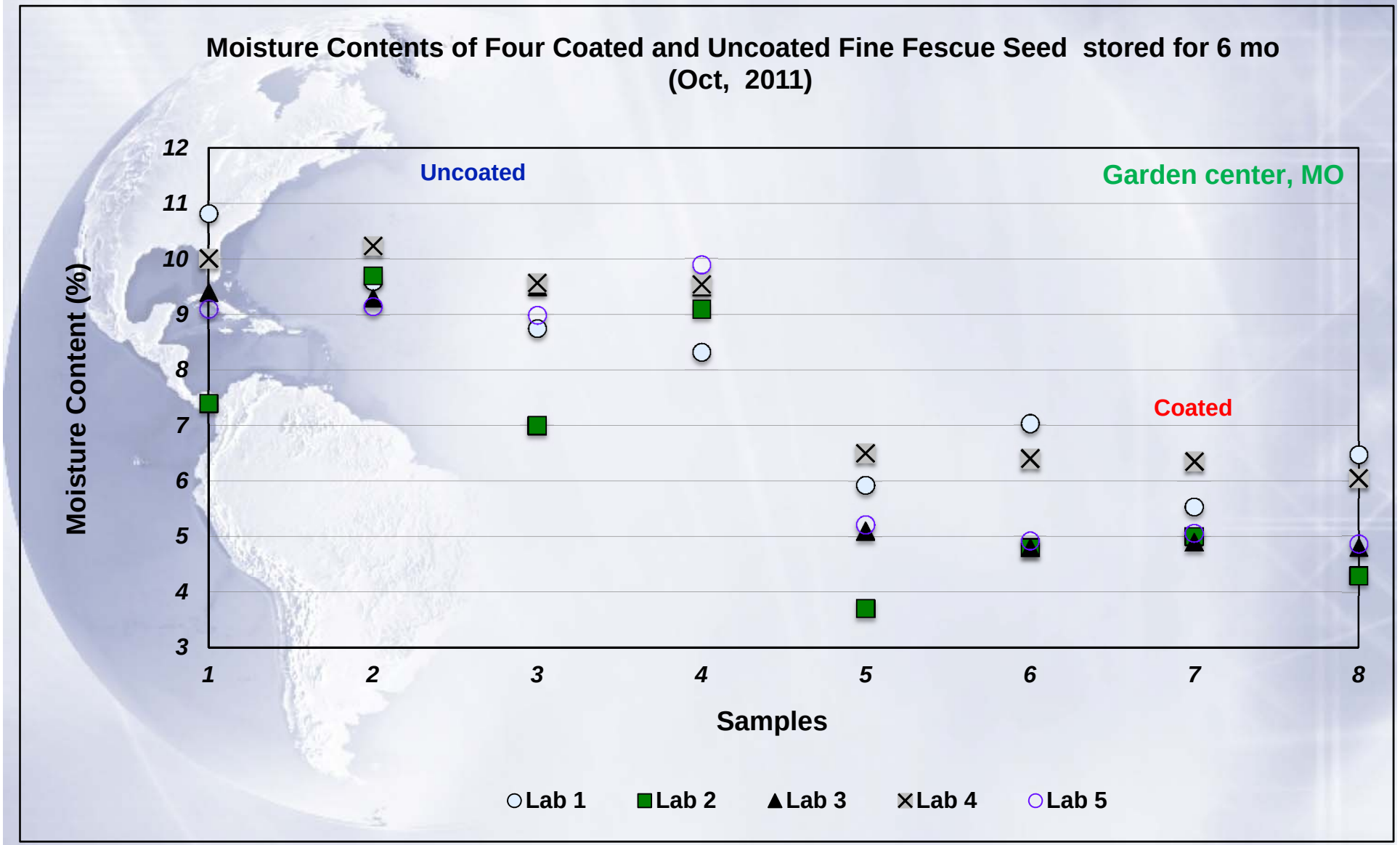


	Lustrous uncoated	Razor uncoated	ACF 266 uncoated	7 Seas uncoated		Lustrous coated	Razor coated	ACF 266 coated	7 Seas coated
Lab 1	75	48	71	73	Samples	80	55	81	85
Lab 2	56	43	52	57		70	55	72	79

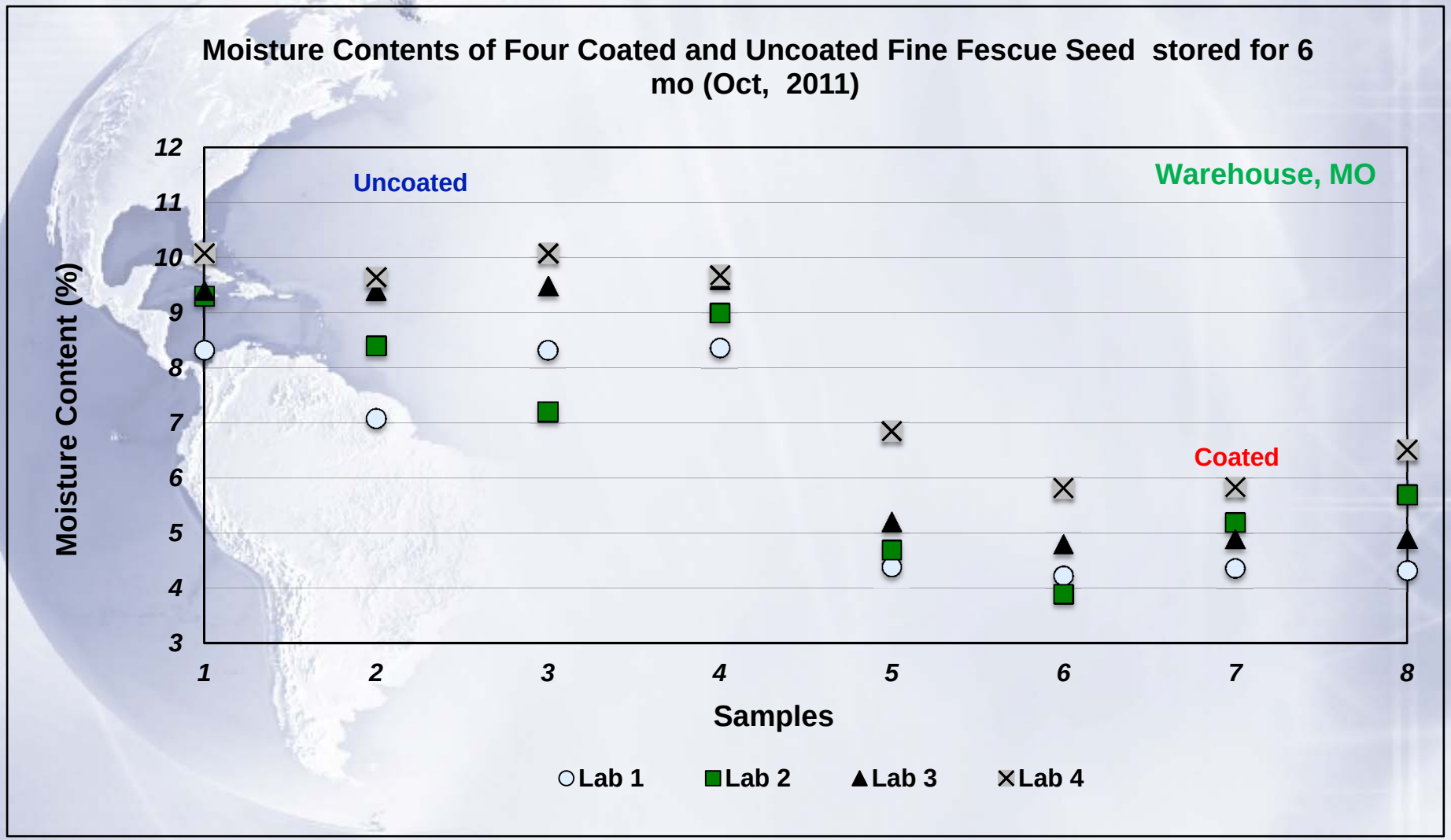
Results - Moisture Content - October 2011 (10° C)



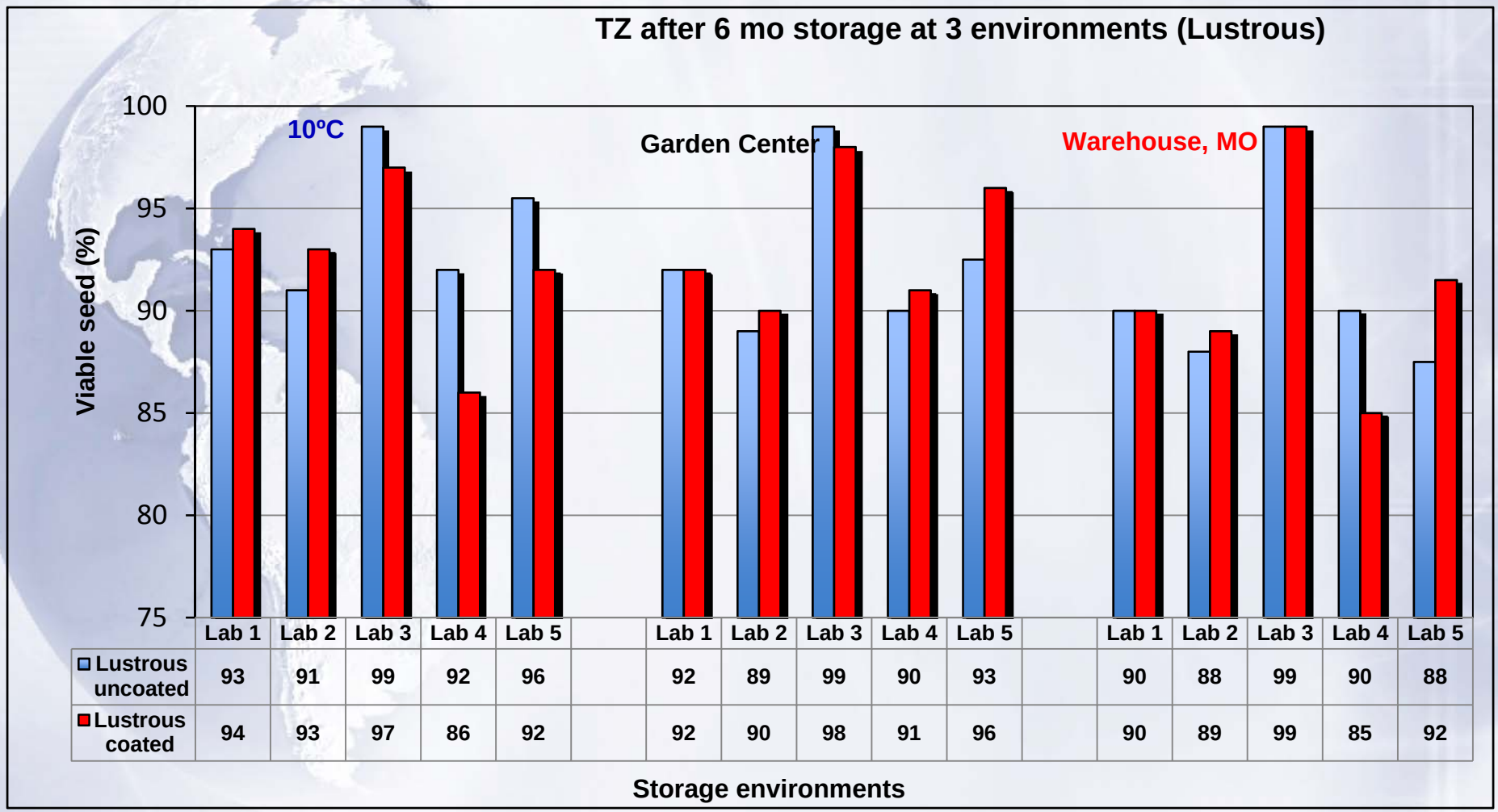
Results - Moisture content - October 2011 (Garden center)



Results - Moisture Content - October 2011 (Warehouse, MO)

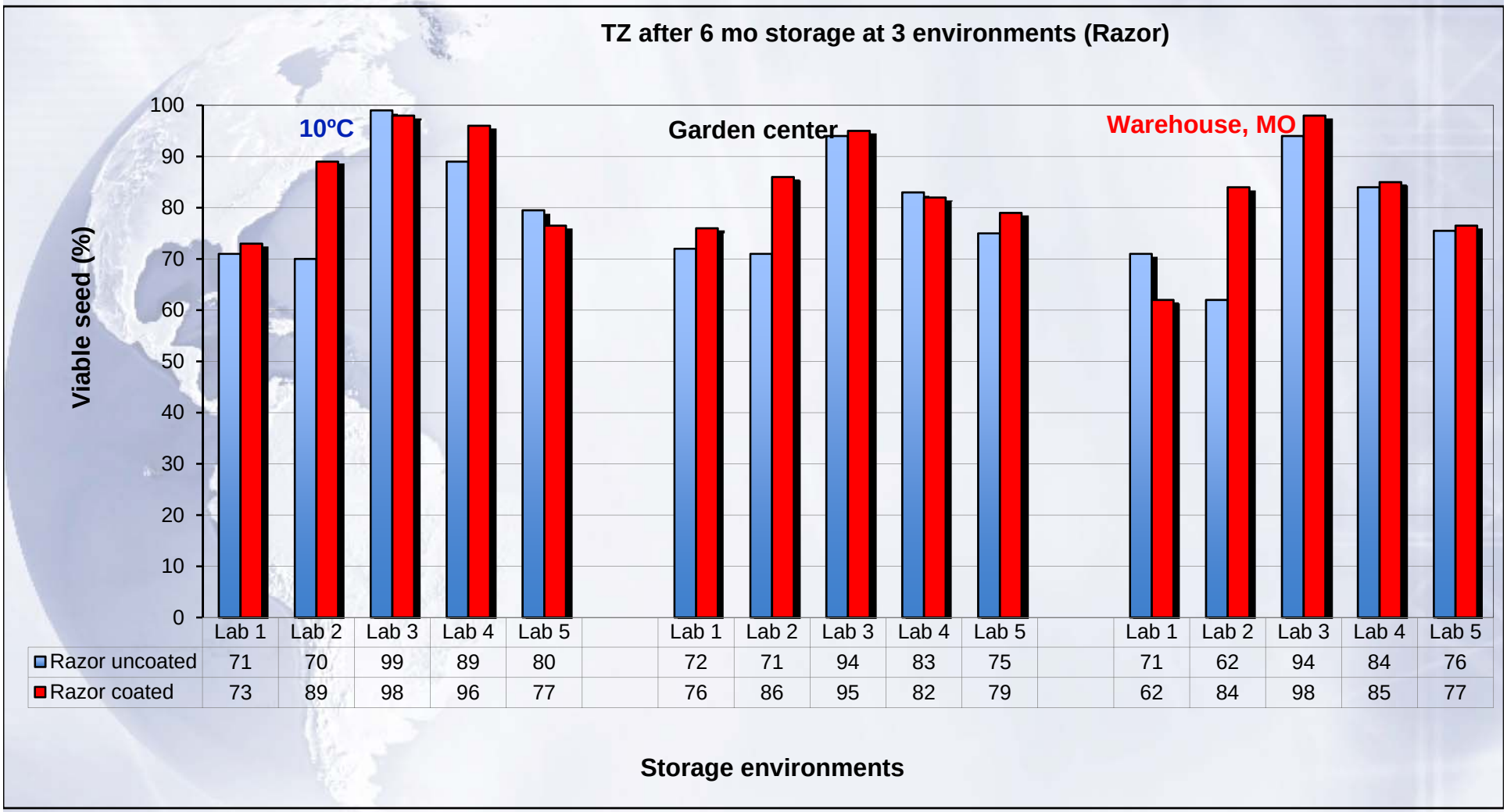


Results - Tetrazolium Test - October 2011 (Lustrous)



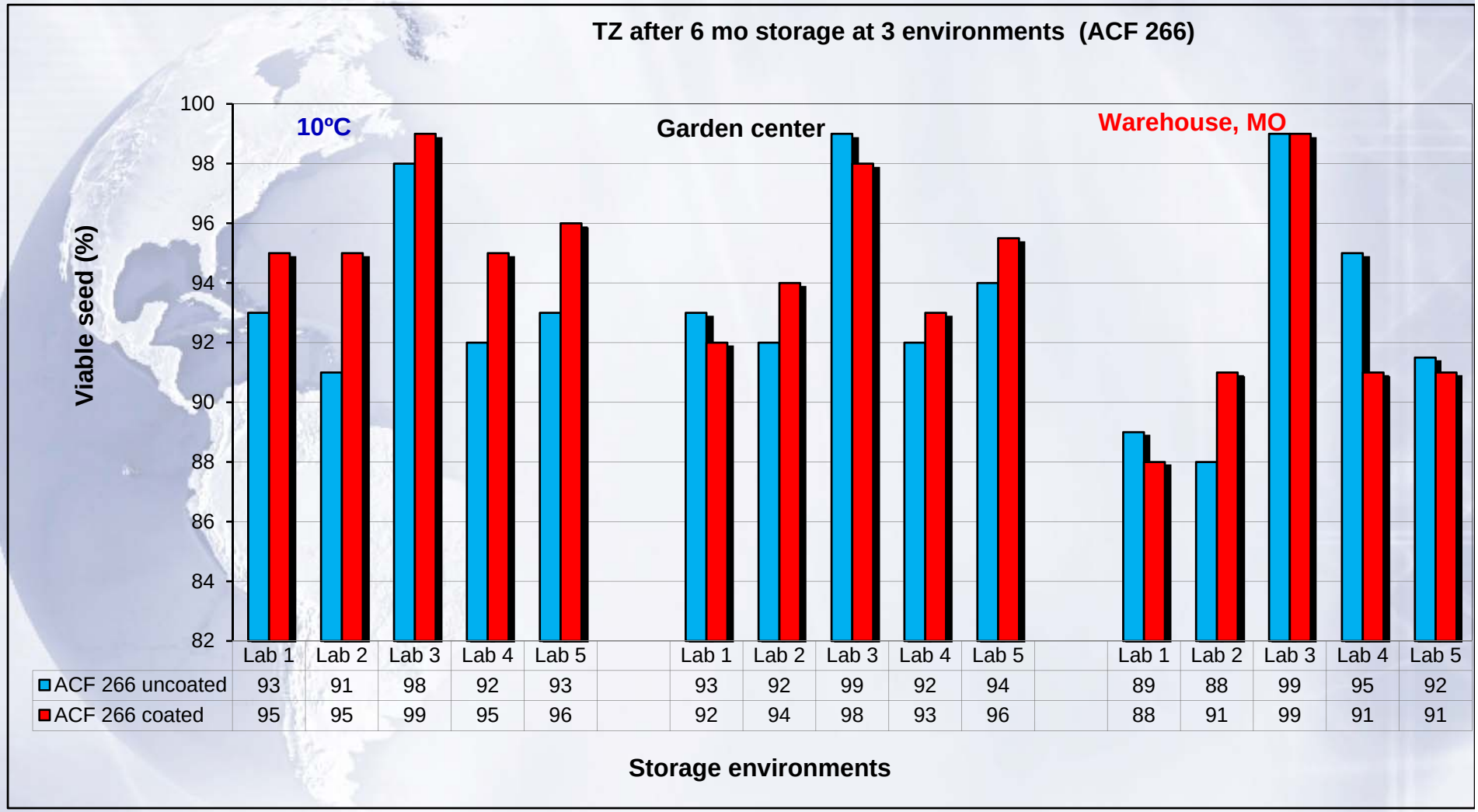
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Lustrous uncoated	93	91	99	92	96		92	89	99	90	93		90	88	99	90	88
Lustrous coated	94	93	97	86	92		92	90	98	91	96		90	89	99	85	92

Results - Tetrazolium Test - October 2011 (Razor)



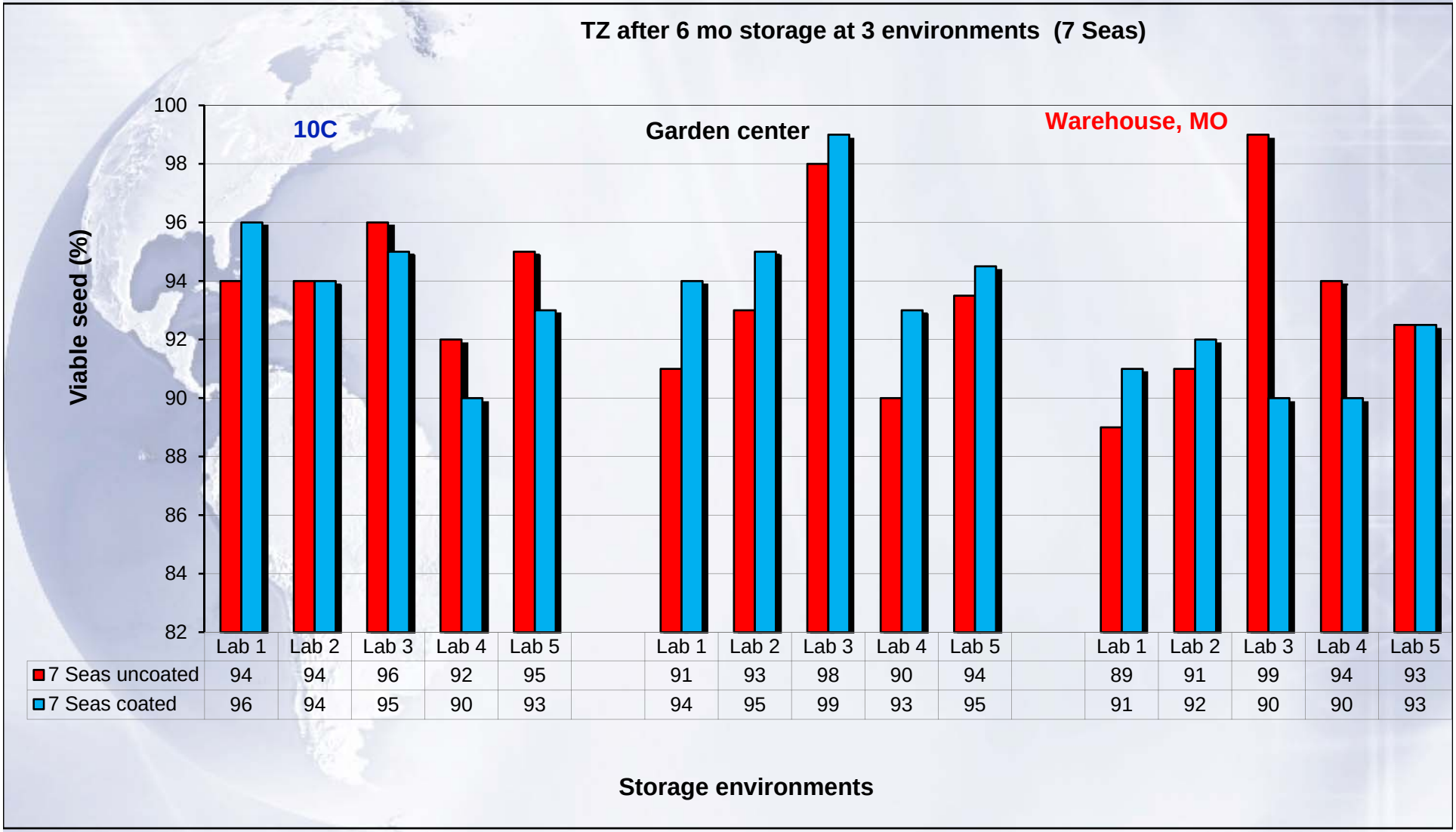
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Razor uncoated	71	70	99	89	80	72	71	94	83	75	71	62	94	84	76
Razor coated	73	89	98	96	77	76	86	95	82	79	62	84	98	85	77

Results - Tetrazolium Test - October 2011 (ACF 266)



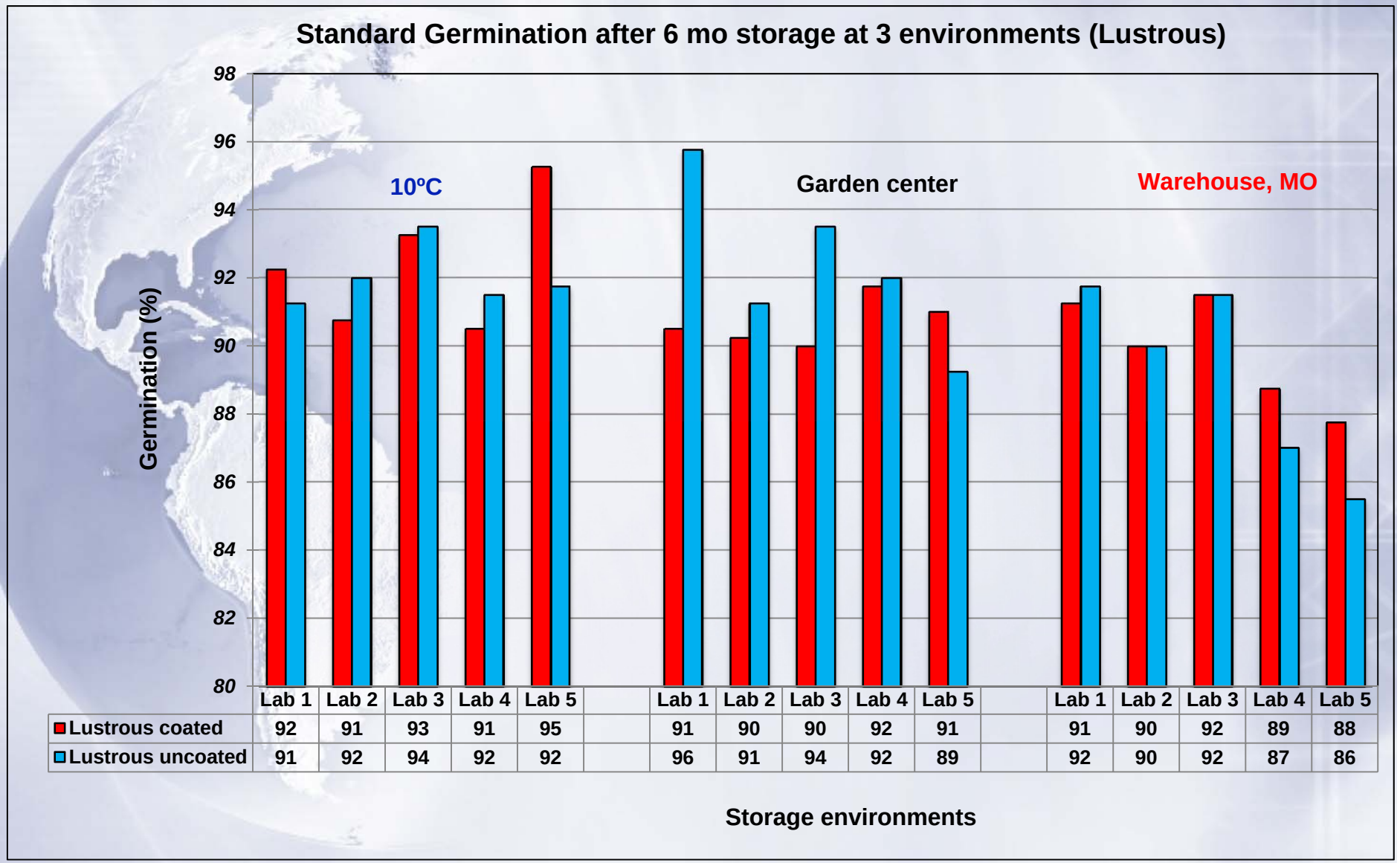
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
ACF 266 uncoated	93	91	98	92	93	93	92	99	92	94	89	88	99	95	92
ACF 266 coated	95	95	99	95	96	92	94	98	93	96	88	91	99	91	91

Results - Tetrazolium Test - October 2011 (7 Seas)



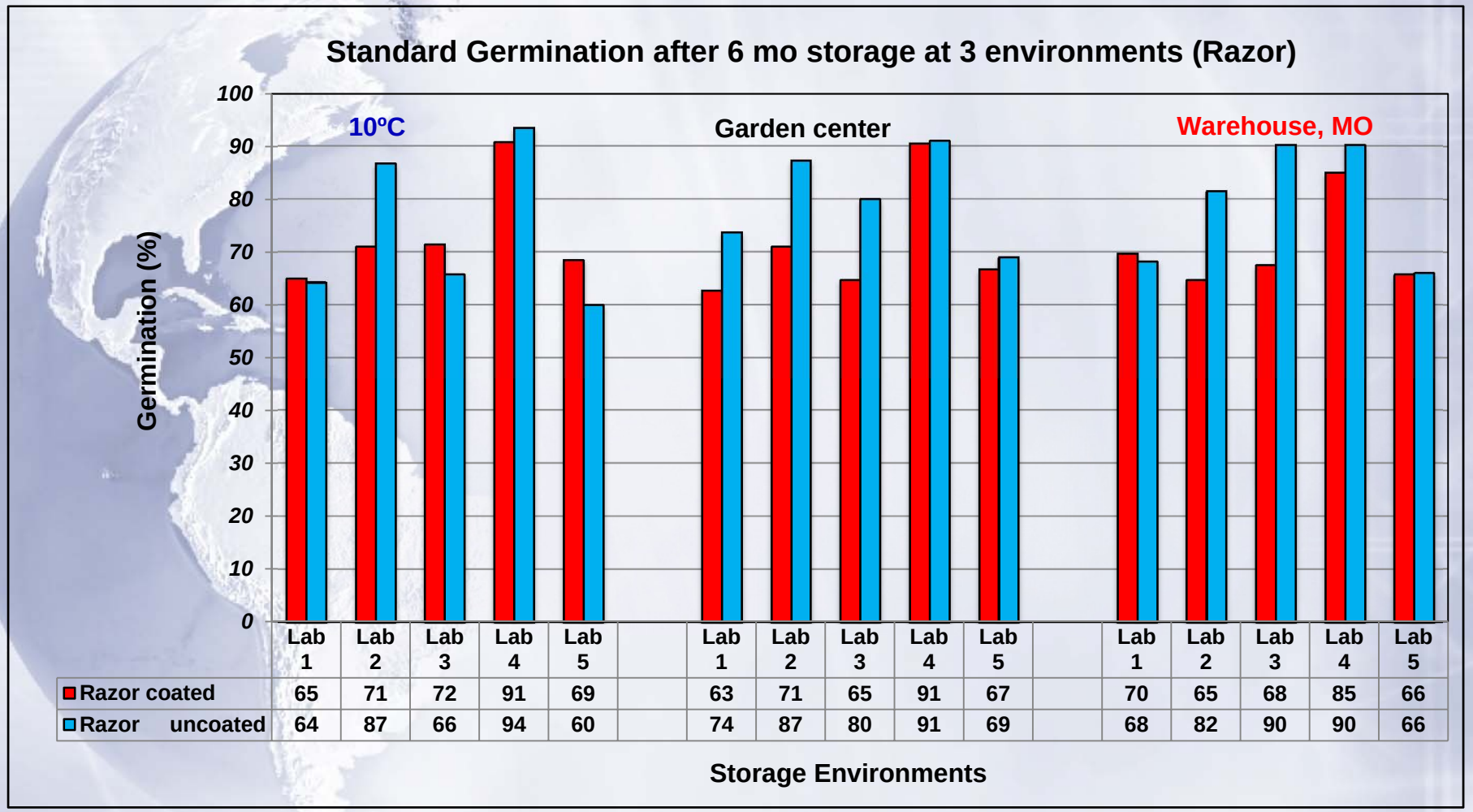
	10C Lab 1	10C Lab 2	10C Lab 3	10C Lab 4	10C Lab 5	Garden center Lab 1	Garden center Lab 2	Garden center Lab 3	Garden center Lab 4	Garden center Lab 5	Warehouse, MO Lab 1	Warehouse, MO Lab 2	Warehouse, MO Lab 3	Warehouse, MO Lab 4	Warehouse, MO Lab 5
7 Seas uncoated	94	94	96	92	95	91	93	98	90	94	89	91	99	94	93
7 Seas coated	96	94	95	90	93	94	95	99	93	95	91	92	90	90	93

Results – Standard Germination Test - October 2011 (Lustrous)



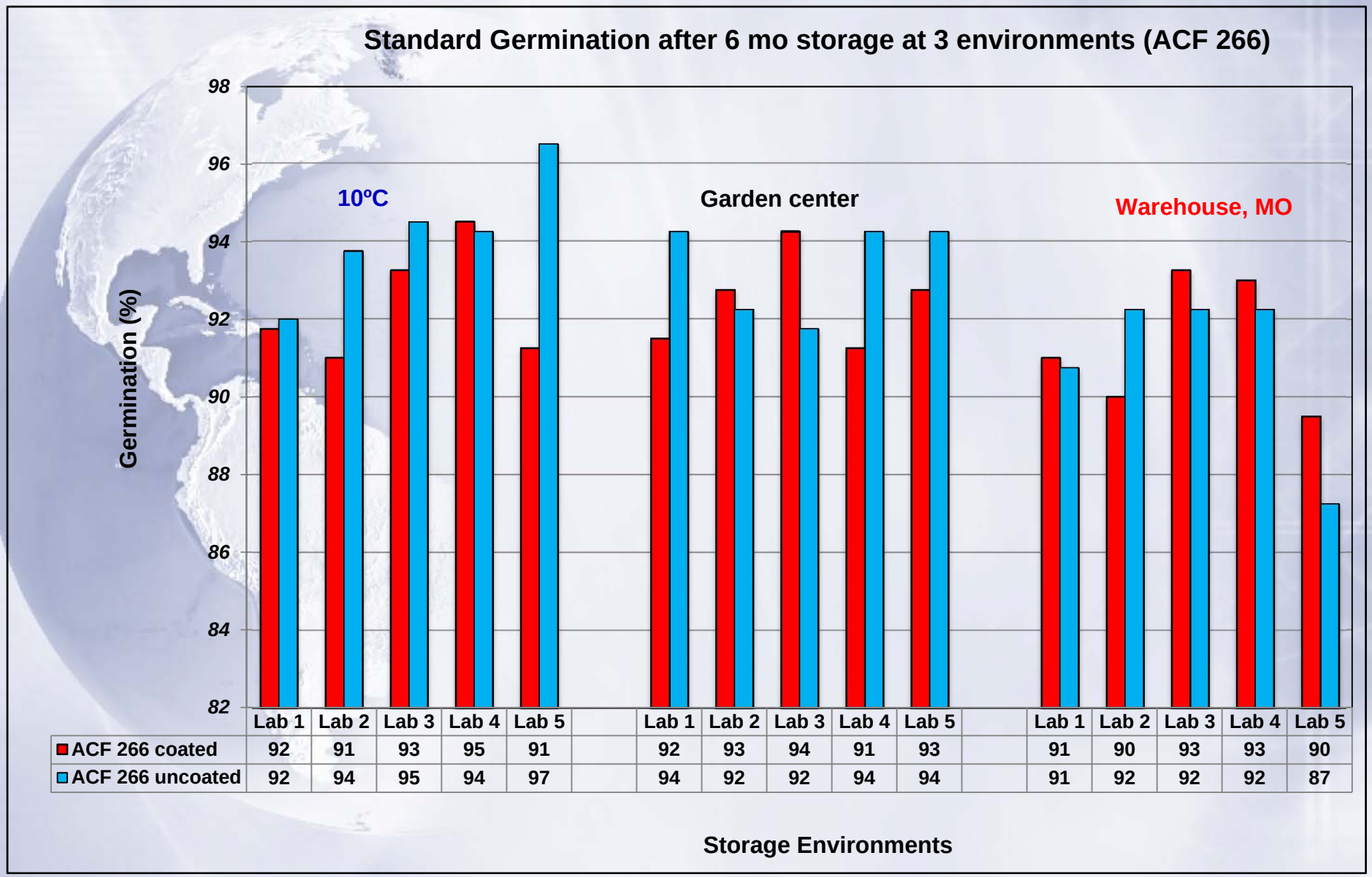
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Lustrous coated	92	91	93	91	95		91	90	90	92	91		91	90	92	89	88
Lustrous uncoated	91	92	94	92	92		96	91	94	92	89		92	90	92	87	86

Results – Standard Germination Test - October 2011 (Razor)



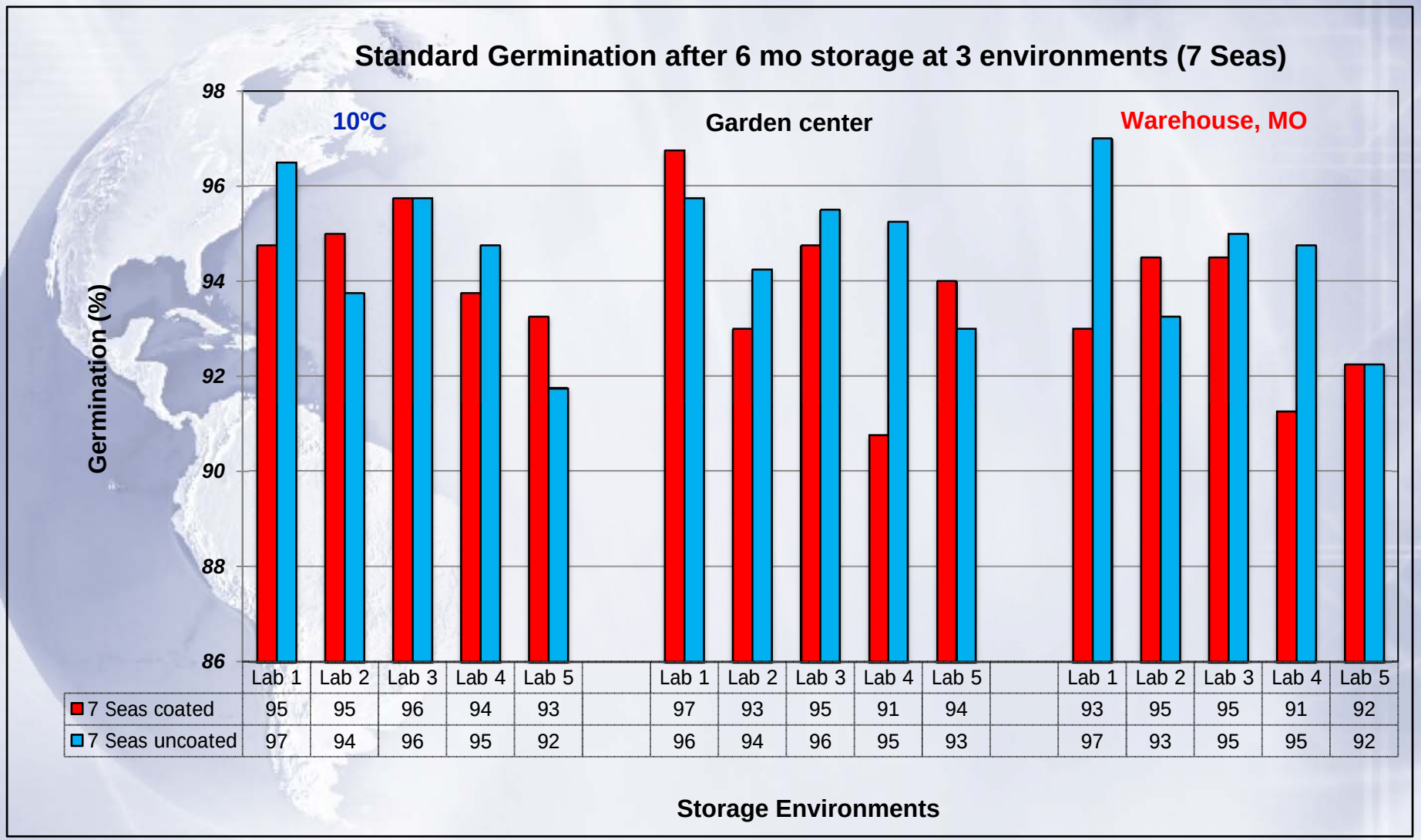
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Razor coated	65	71	72	91	69	63	71	65	91	67	70	65	68	85	66
Razor uncoated	64	87	66	94	60	74	87	80	91	69	68	82	90	90	66

Results - Standard Germination Test - October 2011 (ACF 266)



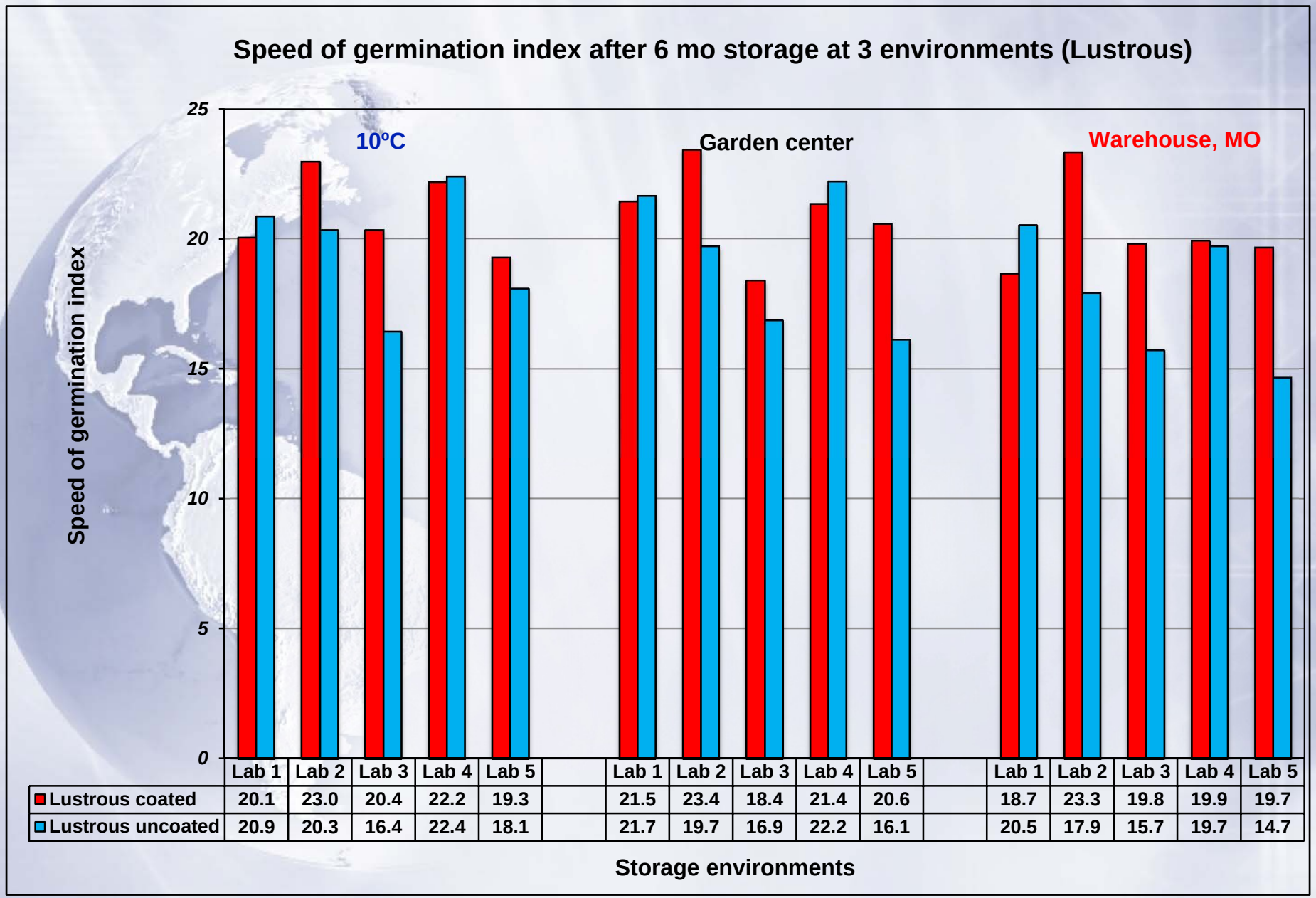
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
ACF 266 coated	92	91	93	95	91		92	93	94	91	93		91	90	93	93	90
ACF 266 uncoated	92	94	95	94	97		94	92	92	94	94		91	92	92	92	87

Results - Standard Germination Test - October 2011 (7 Seas)



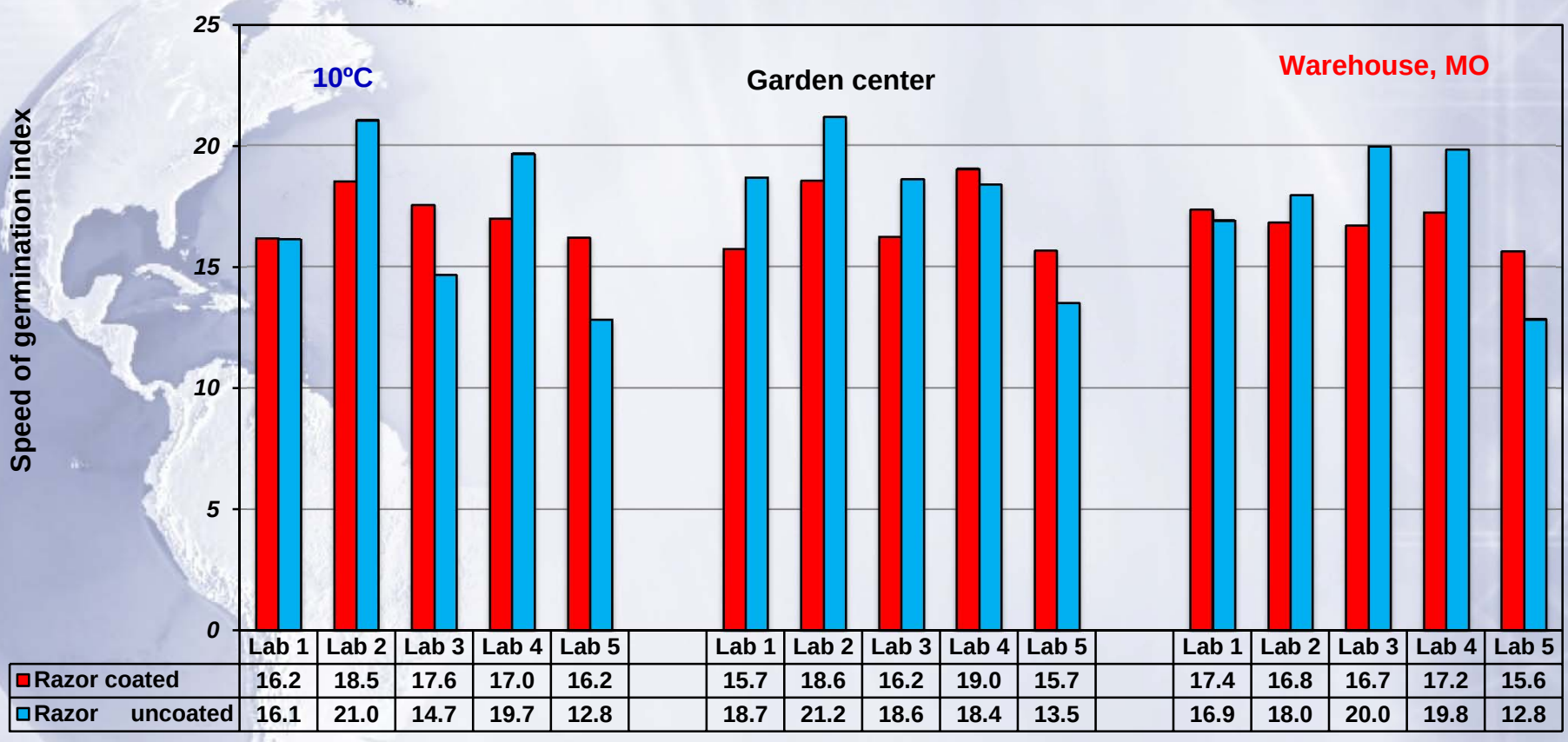
	10ºC					Garden center					Warehouse, MO				
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
7 Seas coated	95	95	96	94	93	97	93	95	91	94	93	95	95	91	92
7 Seas uncoated	97	94	96	95	92	96	94	96	95	93	97	93	95	95	92

Results – Speed of Germination Test - October 2011 (Lustrous)



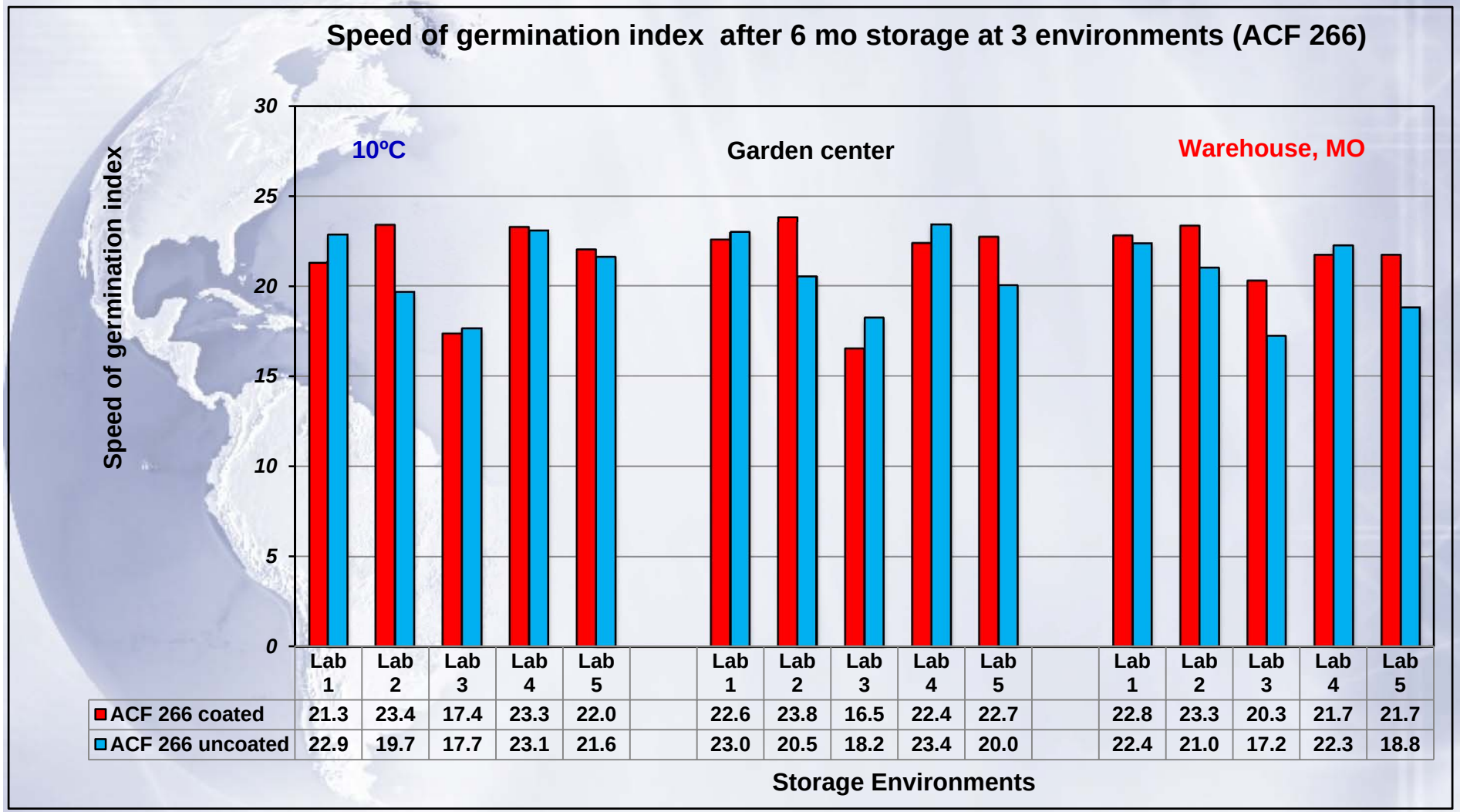
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Lustrous coated	20.1	23.0	20.4	22.2	19.3		21.5	23.4	18.4	21.4	20.6		18.7	23.3	19.8	19.9	19.7
Lustrous uncoated	20.9	20.3	16.4	22.4	18.1		21.7	19.7	16.9	22.2	16.1		20.5	17.9	15.7	19.7	14.7

Results – Speed of Germination Test - October 2011 (Razor)



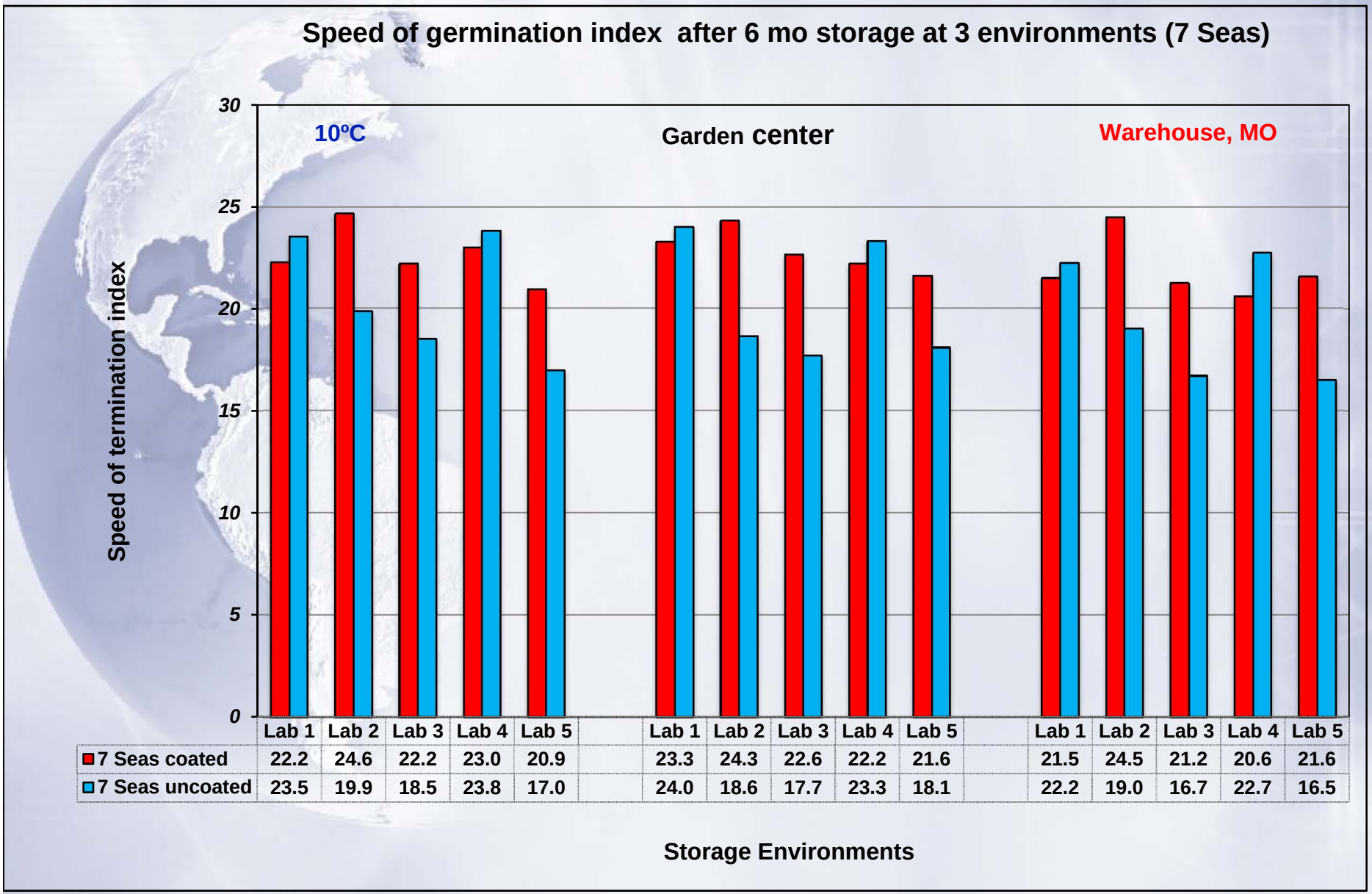
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Razor coated	16.2	18.5	17.6	17.0	16.2		15.7	18.6	16.2	19.0	15.7		17.4	16.8	16.7	17.2	15.6
Razor uncoated	16.1	21.0	14.7	19.7	12.8		18.7	21.2	18.6	18.4	13.5		16.9	18.0	20.0	19.8	12.8

Results – Speed of Germination Test - October 2011 (ACF 266)



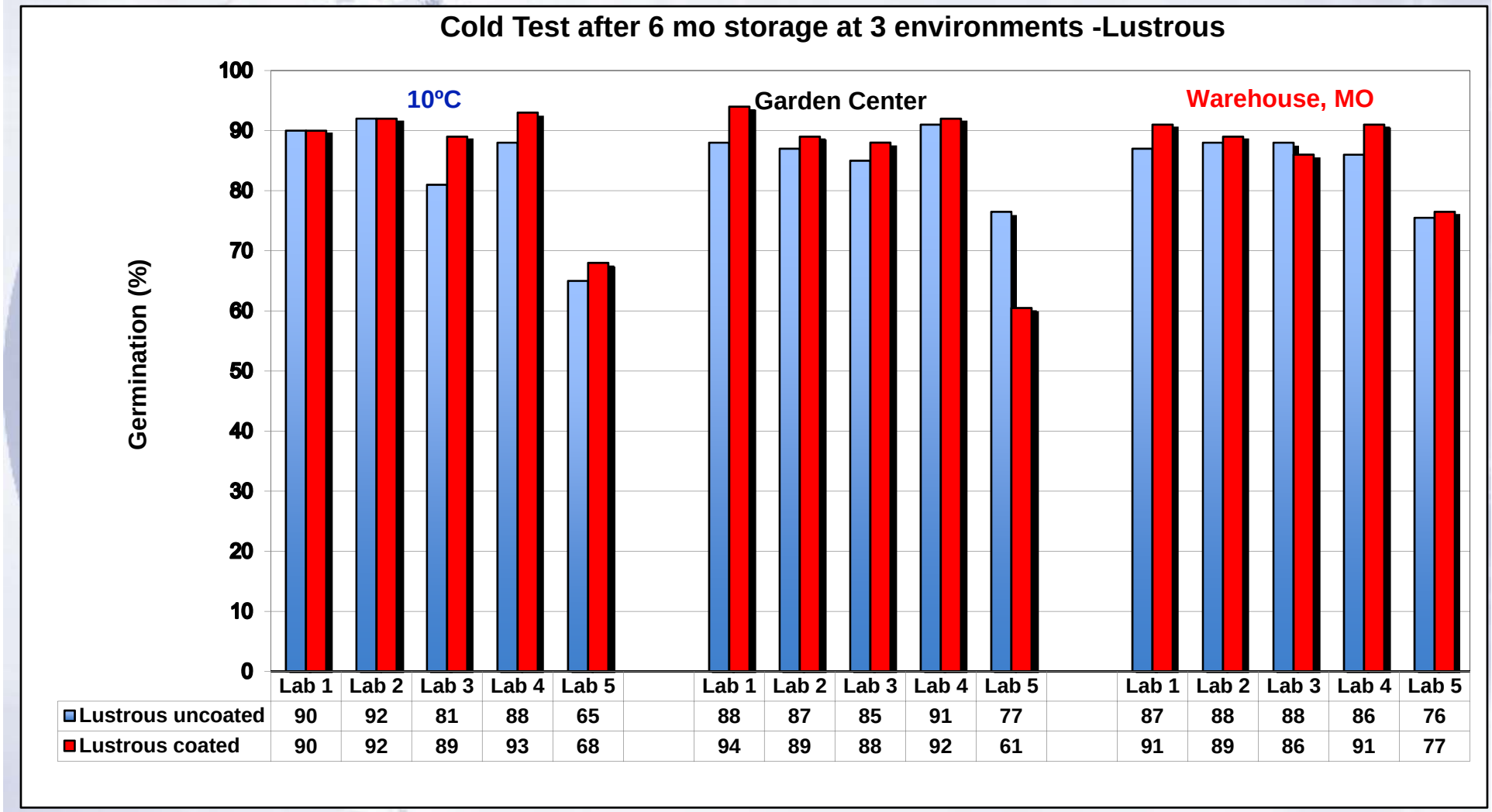
	10ºC Lab 1	10ºC Lab 2	10ºC Lab 3	10ºC Lab 4	10ºC Lab 5	Garden center Lab 1	Garden center Lab 2	Garden center Lab 3	Garden center Lab 4	Garden center Lab 5	Warehouse, MO Lab 1	Warehouse, MO Lab 2	Warehouse, MO Lab 3	Warehouse, MO Lab 4	Warehouse, MO Lab 5
ACF 266 coated	21.3	23.4	17.4	23.3	22.0	22.6	23.8	16.5	22.4	22.7	22.8	23.3	20.3	21.7	21.7
ACF 266 uncoated	22.9	19.7	17.7	23.1	21.6	23.0	20.5	18.2	23.4	20.0	22.4	21.0	17.2	22.3	18.8

Results – Speed of Germination Test - October 2011 (7 Seas)



	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
7 Seas coated	22.2	24.6	22.2	23.0	20.9	23.3	24.3	22.6	22.2	21.6	21.5	24.5	21.2	20.6	21.6
7 Seas uncoated	23.5	19.9	18.5	23.8	17.0	24.0	18.6	17.7	23.3	18.1	22.2	19.0	16.7	22.7	16.5

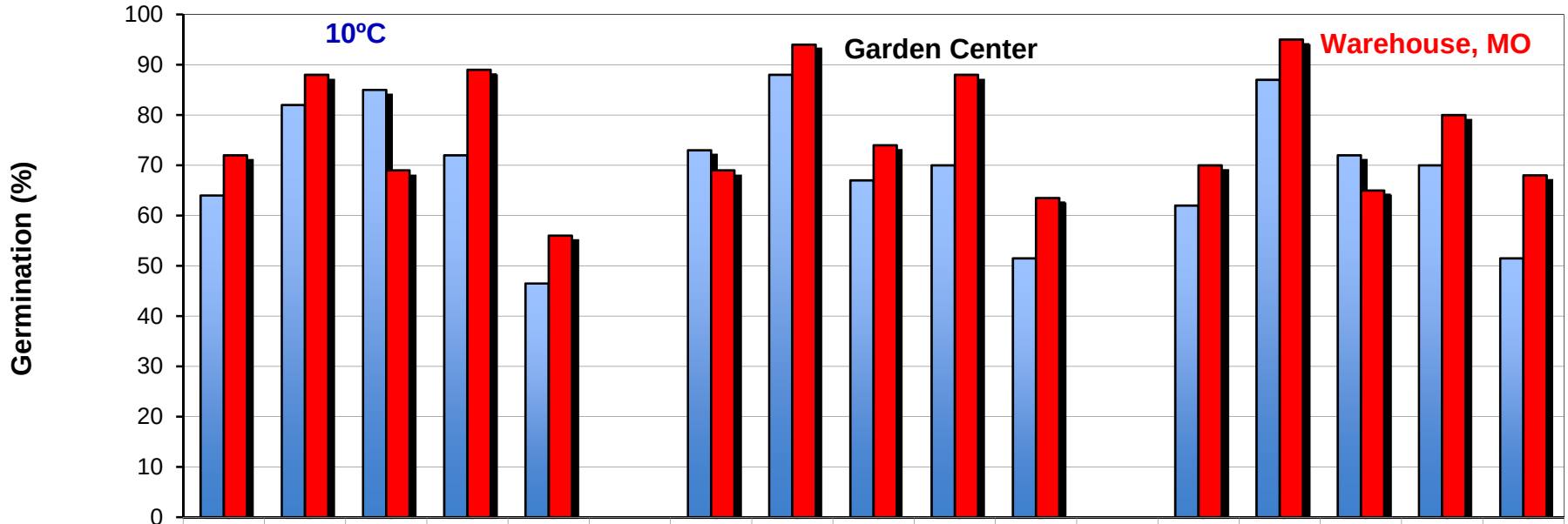
Results - Cold Test - October 2011 (Lustrous)



	10°C					Garden Center					Warehouse, MO				
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Lustrous uncoated	90	92	81	88	65	88	87	85	91	77	87	88	88	86	76
Lustrous coated	90	92	89	93	68	94	89	88	92	61	91	89	86	91	77

Results - Cold Test - October 2011 (Razor)

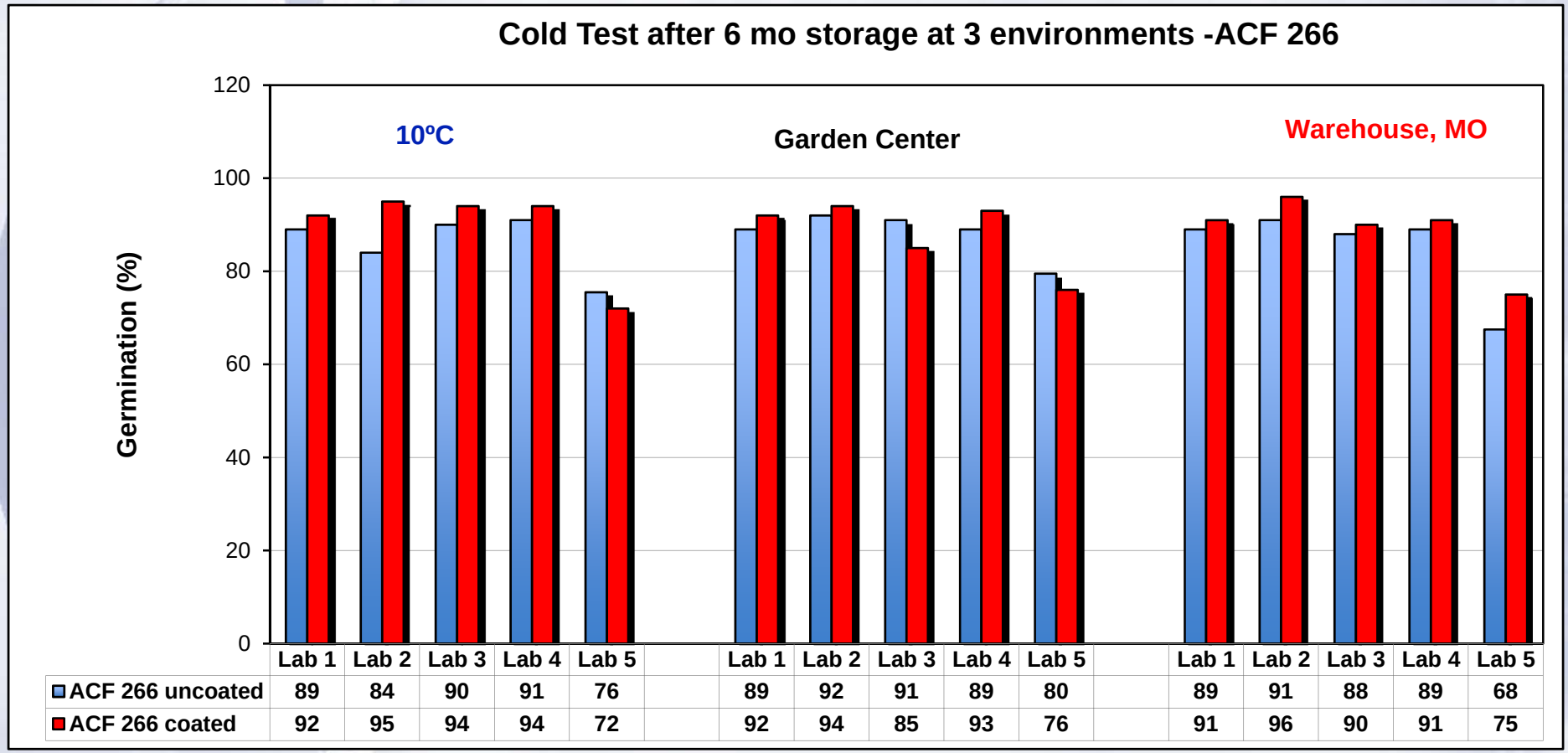
Cold Test after 6 mo storage at 3 environments - Razor



	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5		Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
Razor uncoated	64	82	85	72	47		73	88	67	70	52		62	87	72	70	52
Razor coated	72	88	69	89	56		69	94	74	88	64		70	95	65	80	68

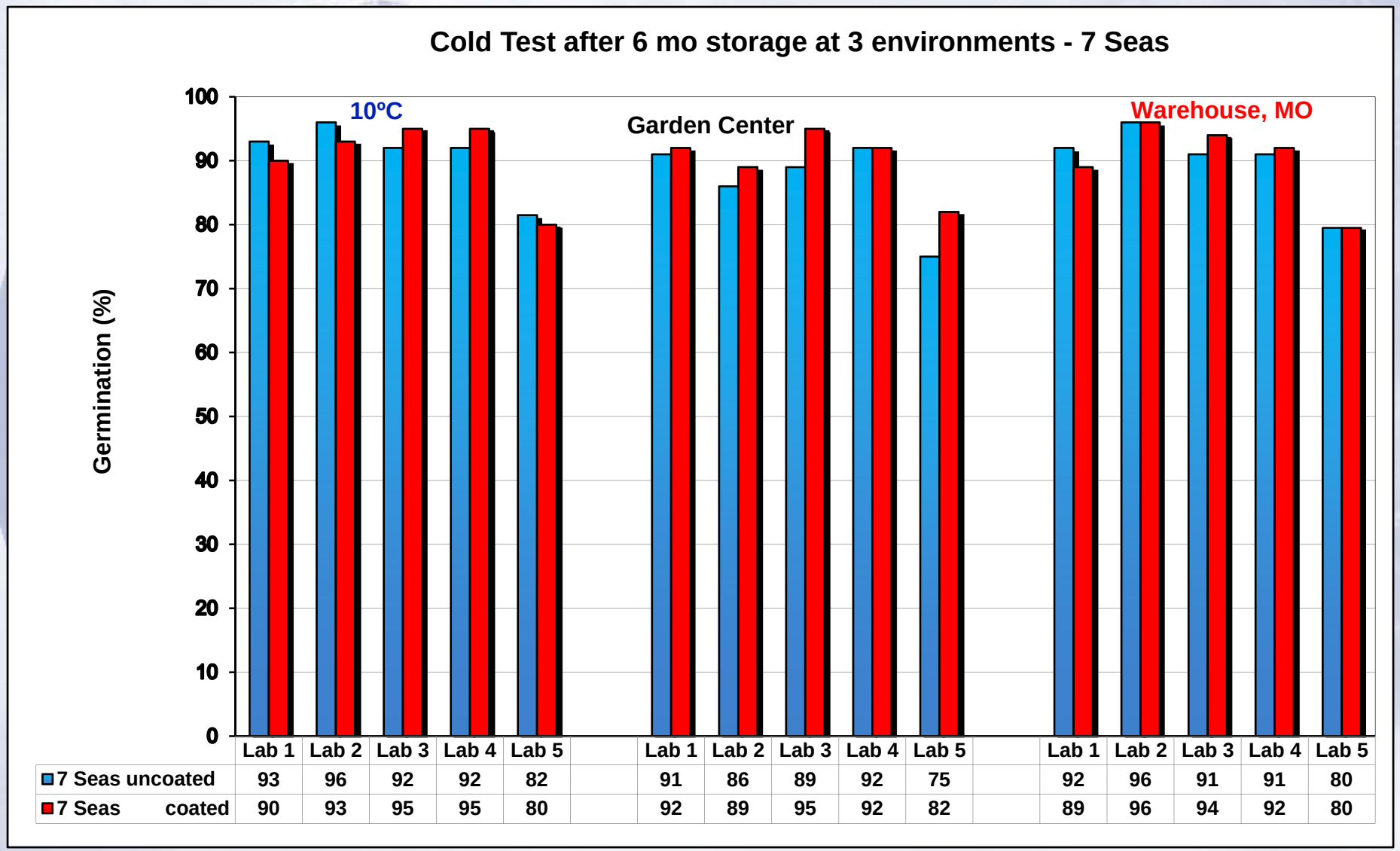
Results

Cold Test - October 2011
ACF 266



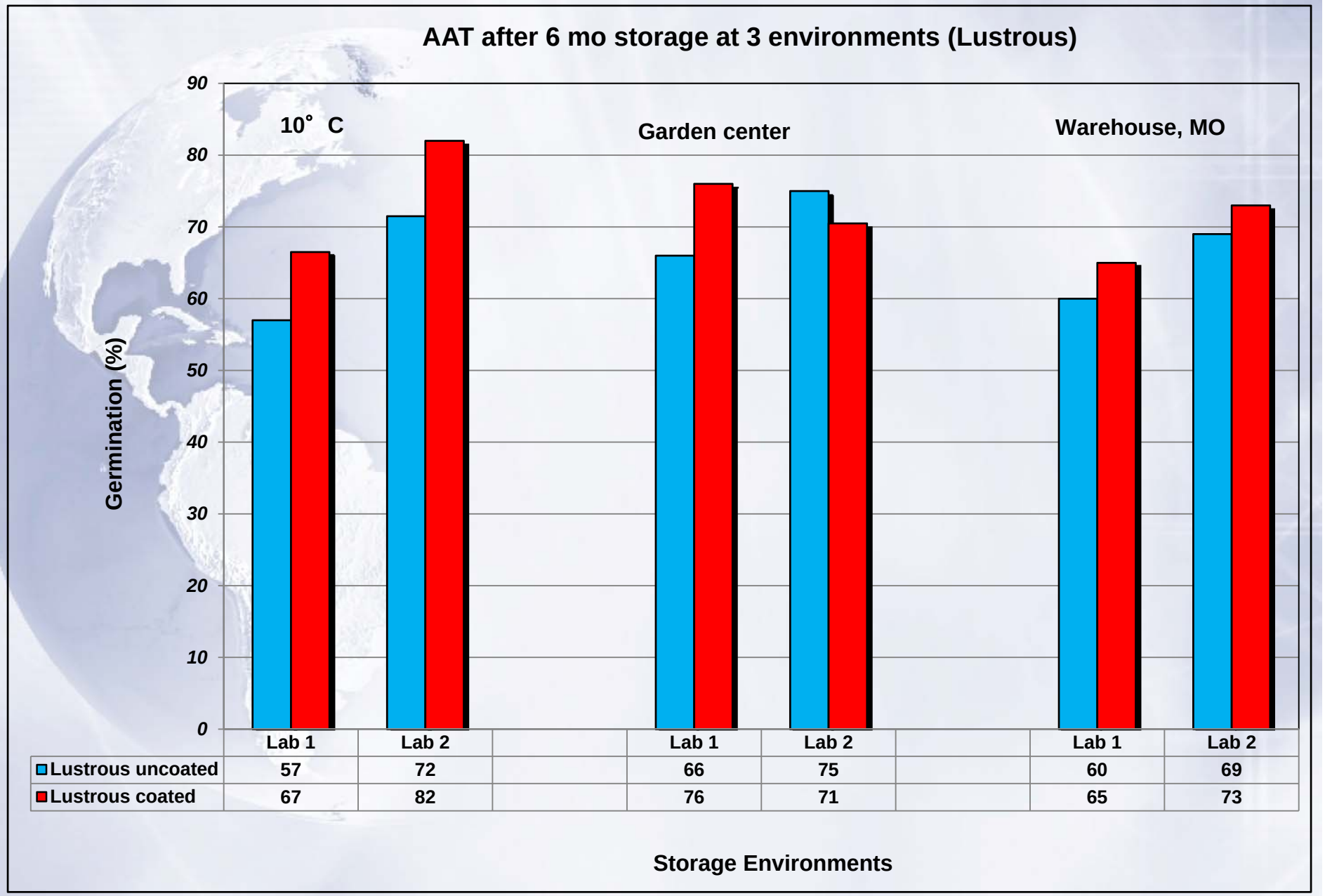
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
ACF 266 uncoated	89	84	90	91	76	89	92	91	89	80	89	91	88	89	68
ACF 266 coated	92	95	94	94	72	92	94	85	93	76	91	96	90	91	75

Results - Cold Test - October 2011 (7 Seas)



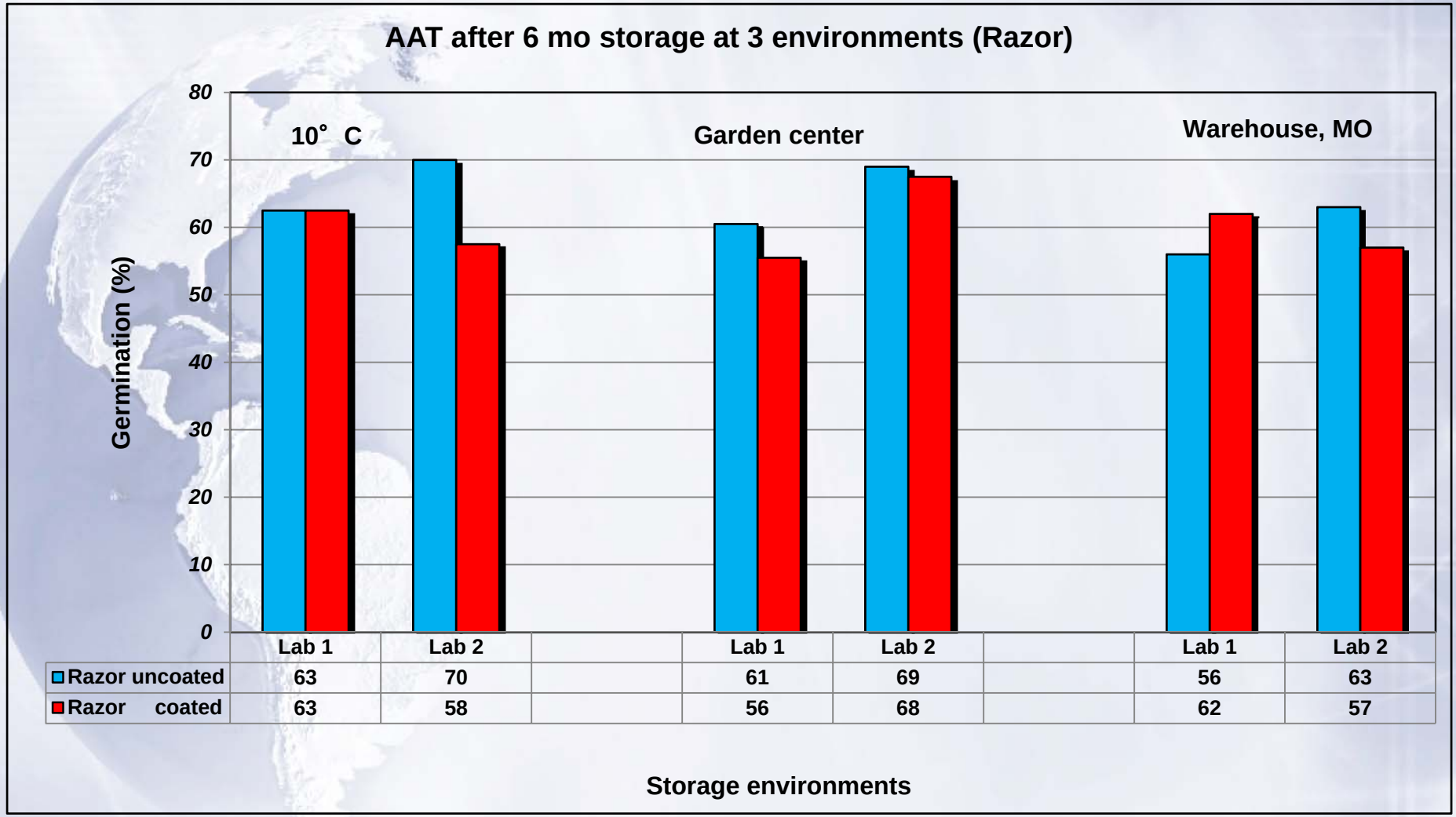
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5
7 Seas uncoated	93	96	92	92	82	91	86	89	92	75	92	96	91	91	80
7 Seas coated	90	93	95	95	80	92	89	95	92	82	89	96	94	92	80

Results - AAT Test - October 2011 (Lustrous)



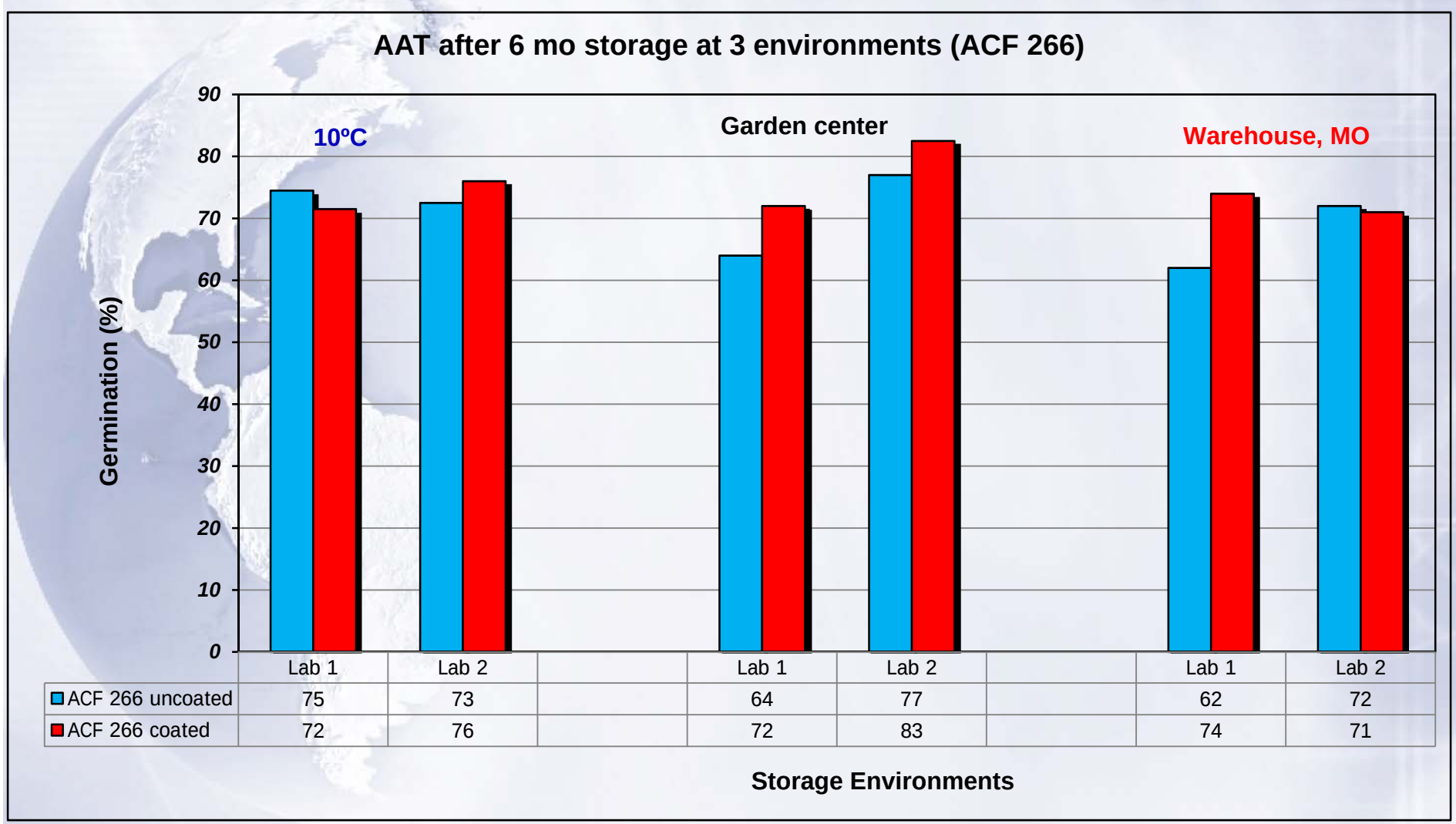
	Lab 1	Lab 2		Lab 1	Lab 2		Lab 1	Lab 2
Lustrous uncoated	57	72		66	75		60	69
Lustrous coated	67	82		76	71		65	73

Results - AAT Test - October 2011 (Razor)



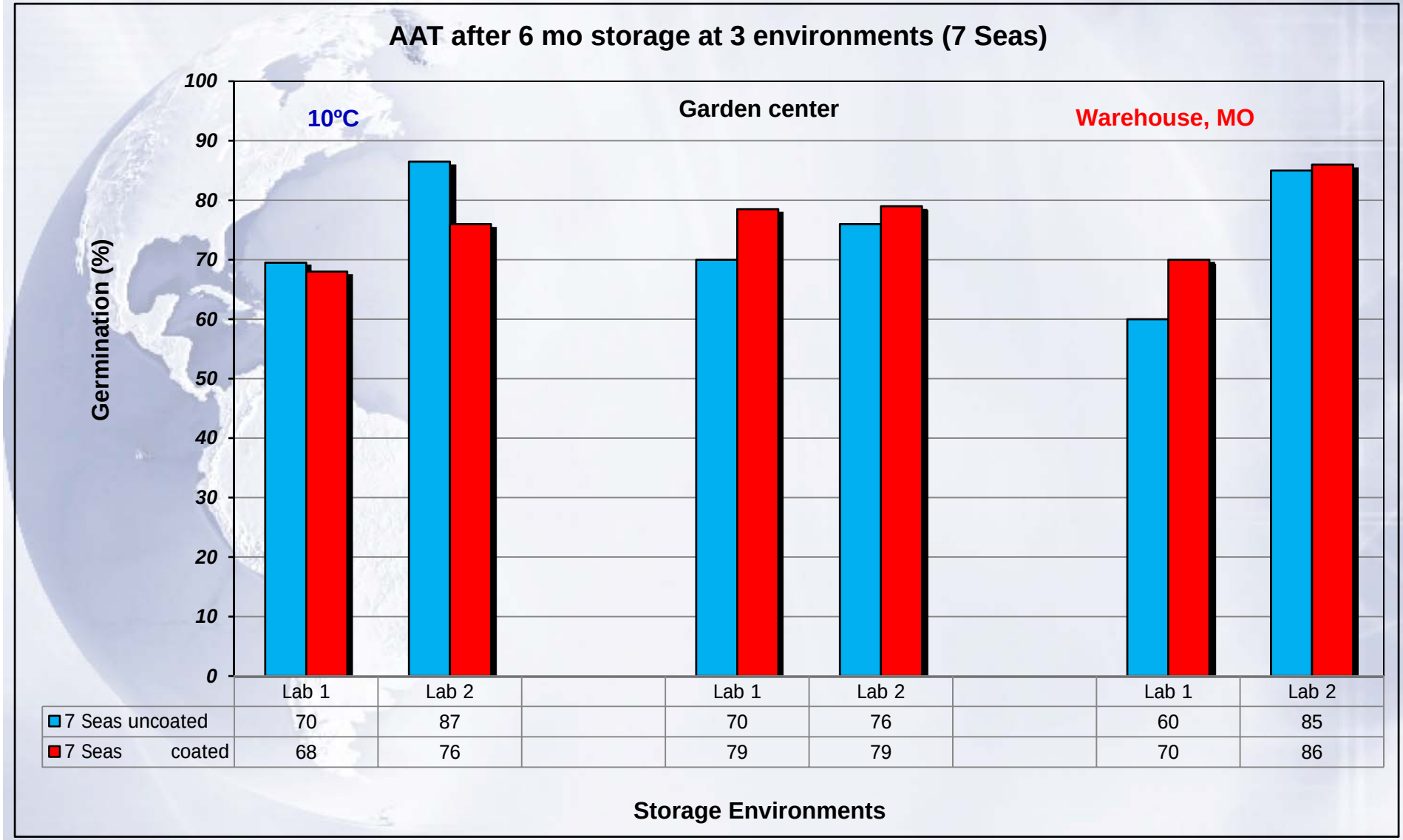
	Lab 1	Lab 2		Lab 1	Lab 2		Lab 1	Lab 2
Razor uncoated	63	70		61	69		56	63
Razor coated	63	58		56	68		62	57

Results - AAT Test - October 2011 - ACF 266



	Lab 1	Lab 2		Lab 1	Lab 2		Lab 1	Lab 2
ACF 266 uncoated	75	73		64	77		62	72
ACF 266 coated	72	76		72	83		74	71

Results - AAT Test - October 2011 (7 Seas)



	Lab 1	Lab 2		Lab 1	Lab 2		Lab 1	Lab 2
7 Seas uncoated	70	87		70	76		60	85
7 Seas coated	68	76		79	79		70	86

Conclusions

- **Seed moisture content of coated seed was significantly less than non-coated seeds.**
- **The initial seed quality before storage of both treated and non-treated seeds of Lustrous, ACF 266, and 7 Seas was high, but not Razor.**
- **After six month of storage under the three different environments, the high quality seed lots)Lustrous, ACF 266, and 7 Seas kept their high quality as indicated by both viability and vigor tests.**
- **The coated seeds of the medium seed quality seed lot Razor performed better than uncoated seeds; but after 6 months both coated and non-coated seeds behaved similarly under all storage conditions.**

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