

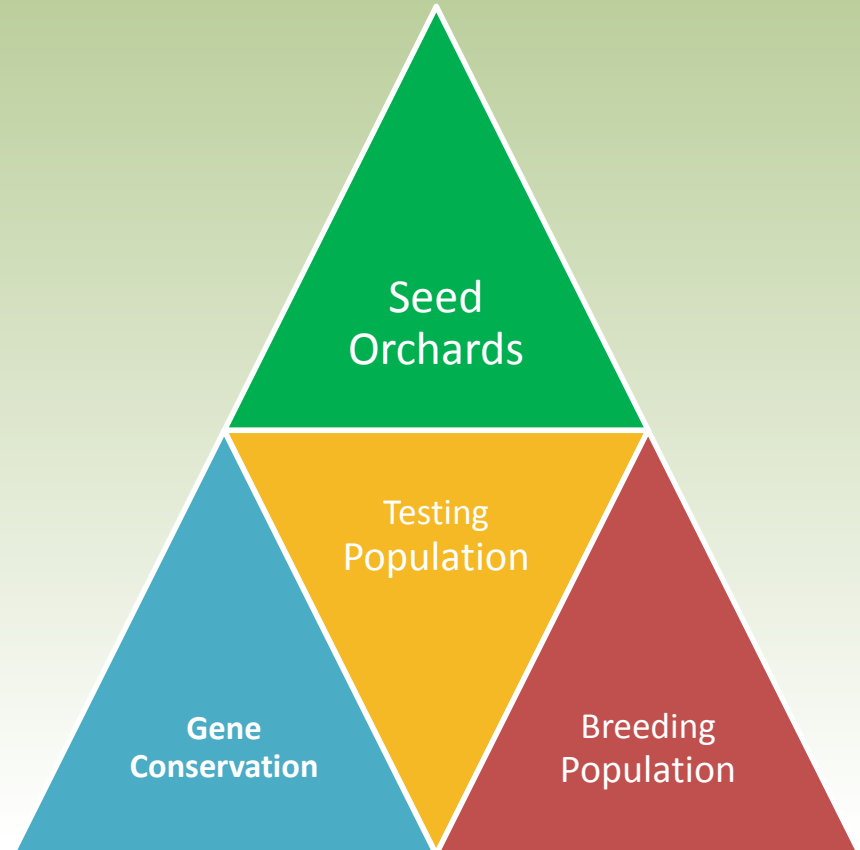
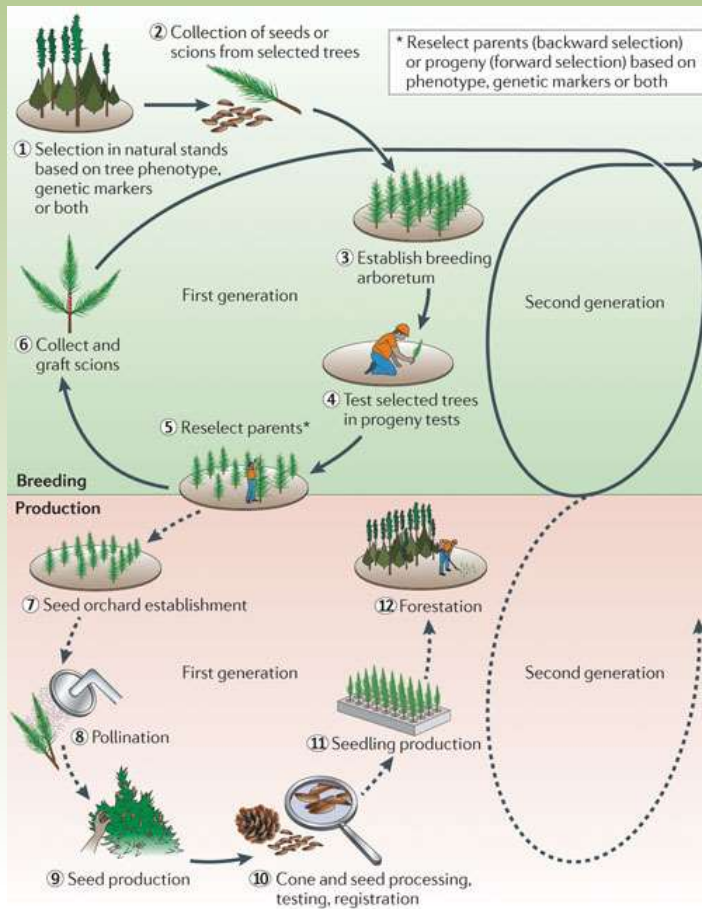
Inland West Whitebark Pine Genetic Restoration Program

**Idaho, Montana, Nevada, Wyoming
Celebrating 20 years**

Mary F. Mahalovich, Regional Geneticist
USFS Northern, Rocky Mountain,
Southwestern and Intermountain Regions



Program elements



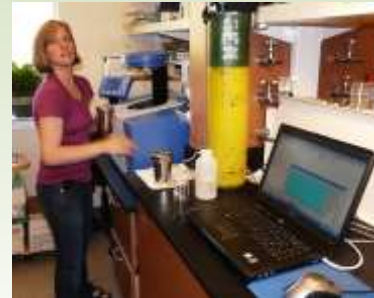
Neale and Kremer (2011)

Nature Reviews | Genetics



Testing population

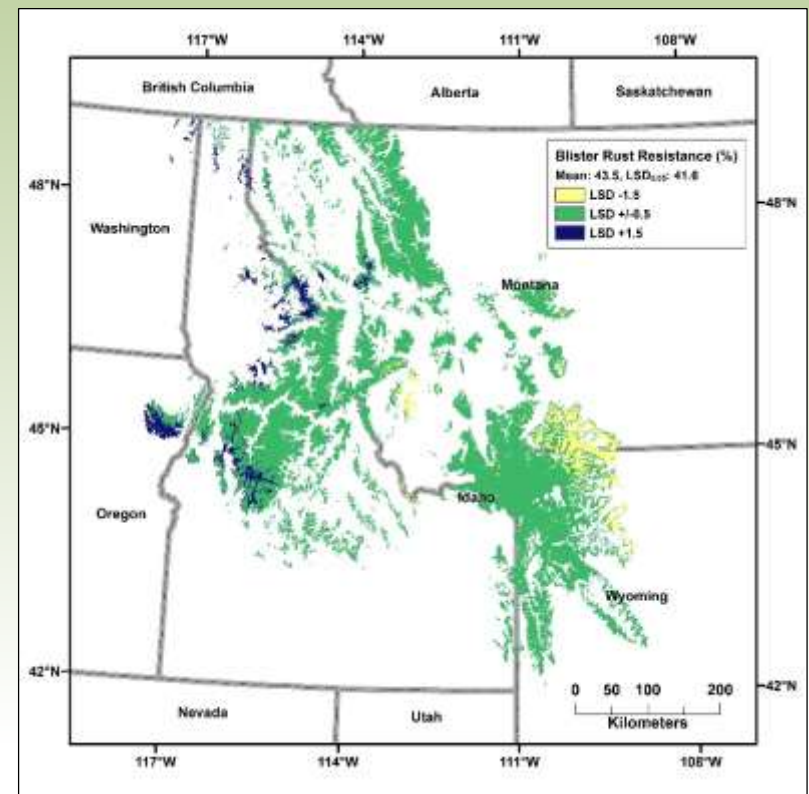
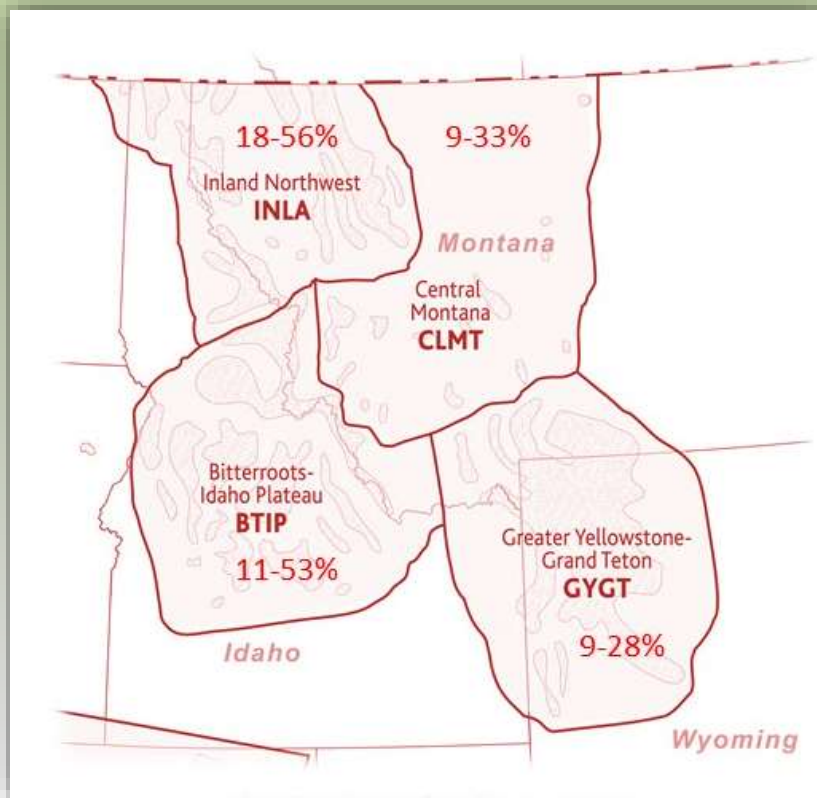
- 1,322 plus trees
- Coeur d'Alene Nursery rust screening trials (7)
- Long-term field tests (7)
- Laboratory trials (stable isotopes, cold hardiness, nutritional ecology) (12)
- Molecular studies (2)
- Planned realized gain trials



Interior rust resistance

47% (\pm 19%) low spore load

27% (\pm 19%) high spore load



Screening for resistance not immunity, no GMOs



Pine nut nutritional ecology

Bulked Lots	Energy (cal/g)	% Crude Fat	% Crude Protein
Resistant	7354.8 (8.26) a ¹	59.19 (1.60) a	19.23 (0.51) a
Susceptible	7144.8 (44.3) b	58.67 (3.09) a	16.88 (0.16) b

Pine nut nutrition favorably correlated with selection for blister rust resistance

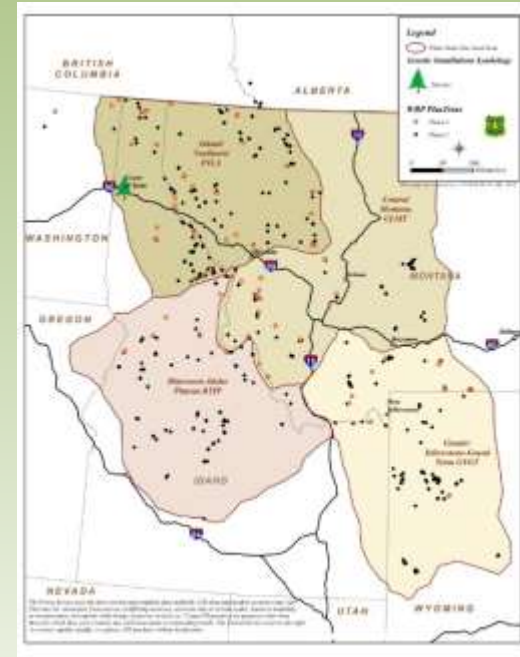


¹ Similar letters are not significantly different at $\alpha = 0.05$.

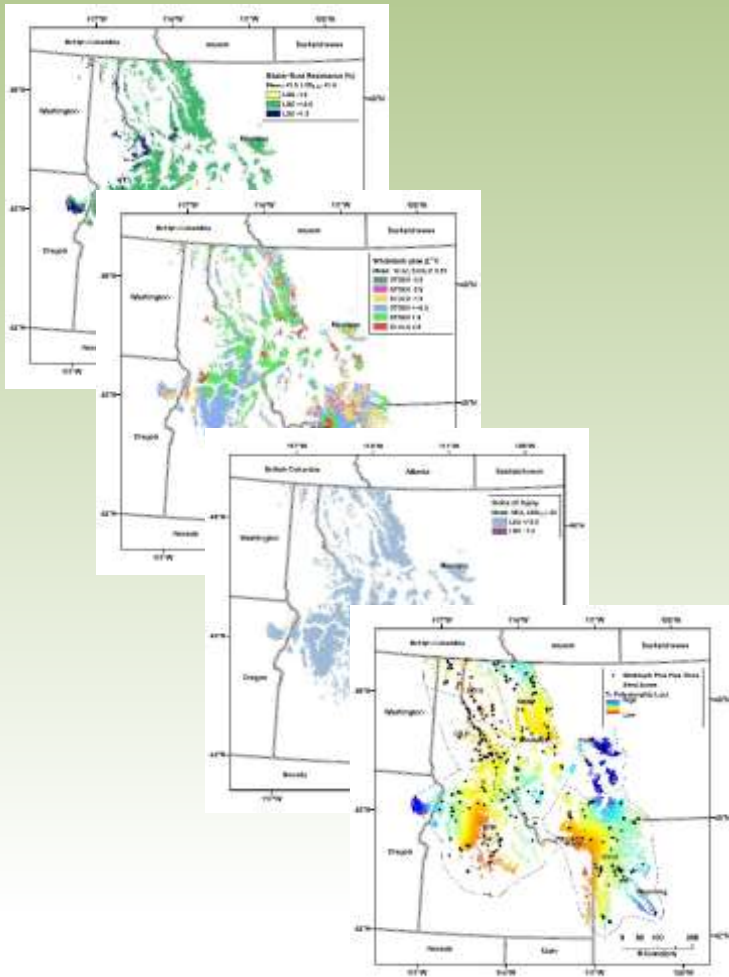


Gene conservation

- Live, leave-tree network of plus trees (~ 1,122)
- Clone banks (4)
- Genetic refugia
- Local and national seed in cold storage 1,836 lbs
- Pollen in cold storage 32 lbs



Genetic refugia



AOGCM ensemble 2040 RCP 8.5

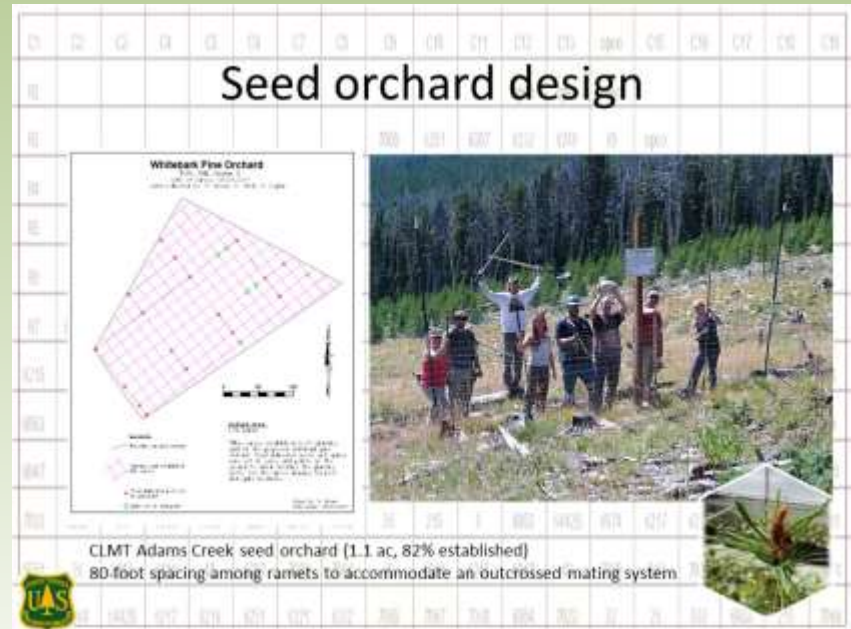
Mean temperature coldest month and precipitation as snowpack



Refugia acres = 1,513,273 (24.4%),
Wilderness acres = 15,040

Seed orchards

- Backwards selection
- Located in field
- Acreage determined by 10-year seed procurement plans



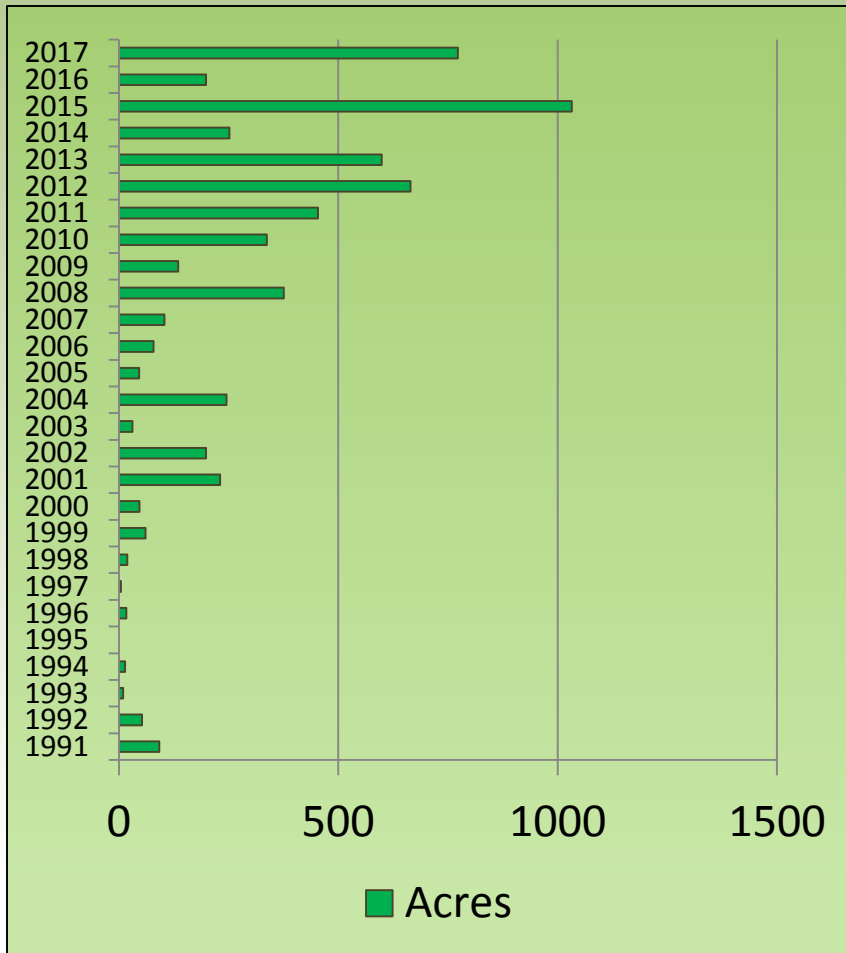
Deployment strategy

- Long-term goal: meet needs from seed orchards
- Interim guidance: utilize blister rust resistance rankings from rust screening trials

Zone	# Plus Trees	COOP	TOWN	RANG E	SEC	LAT	LONG	ELEV	AREA	Bark Reaction	No Spot	Needle Shed	Short Shoot	Total	%Resistant	Resistant Rank	
GYGT	2	NPGT00	44N	116W	34	43.740600	-110.759020	8652	Apex Trail		30	3	1	38	116	62.07	1
GYGT	1	41502	14N	40E	24	44.526090	-111.776215	8000	East Dry Creek		19	0	0	21	83	48.19	2
GYGT	4	40304	42N	117W	14	43.599174	-110.851235	8819	Jack Hole Mtn Resort		63	1	0	49	435	25.98	3
GYGT	2	NPGT00	43N	116W	18 & 20	43.681010	-110.797960	9067	Stewarts Draw		16	1	1	21	152	25.66	4
GYGT	3	41505	44N	117W	7	43.781108	-110.929833	9146	Grand Targhee Ski Resor		33	1	0	52	343	25.07	5
GYGT	1	21405	41N	108W	19	43.500166	-109.853150	9590	Union Pass		11	1	0	8	108	18.52	6
GYGT	1	10207	08S	02W	32	45.101000	-111.869220	8490	Gravelly Range D		10	0	0	13	127	18.11	7
GYGT	2	40302	28N	115W	14	42.413400	-110.450000	9608	Pine Grove		23	0	0	14	234	15.81	8
GYGT	1	10207	09S	02W	5	45.074000	-111.871080	8426	Gravelly Range T		7	0	0	8	104	14.42	9
GYGT	1	40306	44N	111W	34	43.738820	-110.157040	8418	Split Rock Creek		10	1	0	6	126	13.49	10
GYGT	2	11105	04S	05E	11	45.501928	-111.078979	8319	Wheeler Mountain		14	1	0	8	171	13.45	11
GYGT	6	41501	14N	37E	18 & 19	44.524932	-112.142020	8067	Boatman Springs		39	3	0	19	456	13.38	12
25th percentile																	
GYGT	2	40302	28N	115W	9	42.436300	-110.493000	10008	Lake Ridge		13	1	0	12	229	11.35	13
GYGT	1	41505	45N	118W	1	43.887090	-110.958520	8166	Indian Meadows Trail Hea		9	0	0	2	98	11.22	14
GYGT	4	40304	43N	110W	9 & 17	43.691683	-110.069115	9183	Moccasin Basin		18	0	0	19	454	8.15	15
GYGT	4	40302	28N	115W	16	42.415150	-110.487150	100093	Pine Grove Ridge		21	0	0	21	531	7.91	16
GYGT	4	10207	09S	02W	5	45.080218	-111.864230	8384	Gravelly Range H		21	0	0	14	454	7.71	17
GYGT	3	10207	09S	02W	15	45.055647	-111.837943	8538	Gravelly Range B		14	0	0	5	269	7.06	18
GYGT	1	NPYS00	56N	113W	26	44.807860	-110.442320	8936	Washburn Road		7	0	0	2	130	6.92	19
GYGT	2	11106	04S	05E	29	45.465725	-111.130484	8651	Mica Mine		7	0	0	7	209	6.70	20
GYGT	3	10207	08S	02W	30	45.115270	-111.875577	8321	Gravelly Range F		14	0	0	10	366	6.56	21
GYGT	3	40302	28N	115W	21	42.400267	-110.490667	10268	Deadline		15	1	0	4	306	6.54	22
50th percentile																	



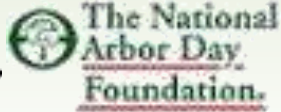
Interior planting accomplishments 7,686 acres (1988-2017)



Acknowledgements/Partners

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