MSU RESEARCH UPDATE

CoFirGE: The Collaborative Fir Germplasm Evaluation

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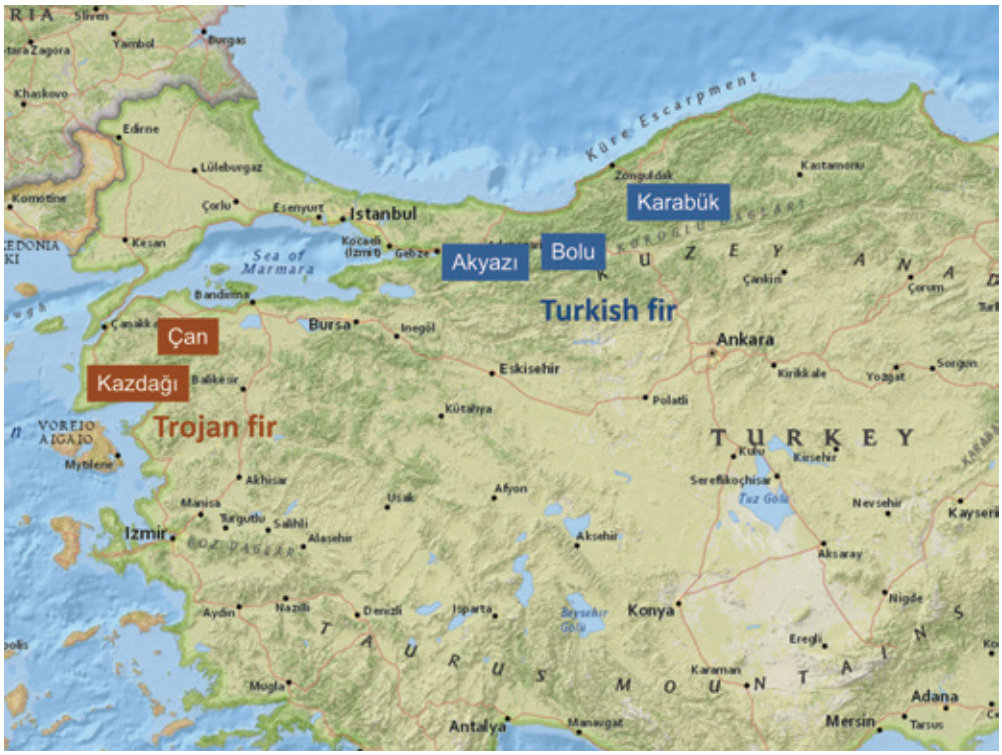

Figure 1. Seed collection areas for CoFirGE project in northwestern Turkey

Figure 2. Chal Landgren (Oregon State University) assembles CoFirGE seedlings for distribution to collaborators.

In the spring of 2013 researchers from Michigan State University and MSU Extension installed two test plantations in Michigan as part of the CoFirGE collaborative effort to evaluate Turkish fir (Abies bornmuelleriana) and Trojan fir (Abies equi-trojani) accessions. Seedlings for the trial were produced as plug seedlings from seed collected in northwestern Turkey by John Frampton (North Carolina State University), Gary Chastagner (Washington State University) and Chal Landgren (Oregon State University). The goal of the CoFirGE project is to evaluate Turkish fir and Trojan fir for use as Christmas trees across production regions of the United States and Denmark. These Mediterranean firs are of interest in many regions of the country because of their desirable Christmas tree traits (deep green needles, form and growth rate) and resistance to phytophthora root rot.

The team collected seed from 20 trees (maternal parents) in each of three provenances of Turkish fir and from 20 trees of two provenances of Trojan fir (Fig. 1). In total, the collection produced 100 open-pollinated families from five provenances. Seedlings were grown at Kintigh's Mountain Home Ranch nursery in Springfield, OR and then distributed to cooperators in the Pacific Northwest, North Carolina, Pennsylvania, Connecticut, and Michigan (Fig. 2 & 3). In addition to the Turkish and Trojan fir accessions, check-lots of seedlings representing species that are commonly grown in each of cooperating regions (Fraser fir (Abies fraseri), concolor fir (A. concolor), noble fir (A. procera), balsam fir (A.balsamea), grand fir (A. grandis), Korean fir (A. koreana), and Nordmann fir (A. nordmanniana)) were also included. Each collaborator installed two test plantations. The test plantations consisted of 3,000 seedlings; 30 replications of each check-lot species and each family of Turkish and Trojan fir (seed germination was low on some Turkish and Trojan fir families, therefore some provenances had less than 20 families).

We installed CoFirGE plantations at the MSU Tree Research Center near East Lansing and at Antioch tree farm near Mesick. At the MSU site, seedlings were hand-planted on May 21, 2013. At the Mesick site, trees were machine planted using the cooperator's equipment on May 10, 2013. Since the plantations were established, weather conditions were warmer and slightly dryer at East Lansing then at Mesick, although annual maximum high temperatures have been similar (Table 1). The coldest weather for each site occurred in February 2015 (-19.3 deg. F at East Lansing, -22.4 deg. F at Mesick). We measured heights on the trees each fall since their installation and assessed tree condition and leader status. For this report, we present the most recent data from the fall 2018 assessment.

Performance of the trees varied between sites and among species and provenances. Overall, tree survival was higher at Mesick (92.8%) than in East Lansing (62.7%)

Table 1.
Mean, minimum, and maximum annual temperatures and annual precipitation at Mesick and East Lansing CoFirGE sites

	Average temperature (Deg F)		Minimum temperature (Deg F)		Maximum temperature (Deg F)		Precipitation (inches)	
	Mesick	East Lansing	Mesick	East Lansing	Mesick	East Lansing	Mesick	East Lansing
2013[a]	51.4	54.1	-8.9	-4.6	95.0	92.1	19.0	19.6
2014	42.0	45.8	-18.7	-14.7	88.1	88.5	35.4	24.0
2015	45.1	48.1	-22.4	-19.3	93.2	88.6	29.0	27.0
2016	47.4	49.9	-4.2	-4.3	93.9	93.5	28.0	27.4
2017	46.0	49.3	-7.8	-15.1	93.9	93.9	35.0	30.6
2018[b]	46.4	48.9	-11.5	-8.2	94.0	93.7	28.5	26.8

Source: MSU EnviroWeather
a June 1 – Dec. 31, 2013
b Jan. 1 – Dec. 12, 2018

Table 2
Mean tree condition rating, leader rating and survival of Turkish and Trojan fir provenances and check-lot species in CoFirGE trial, fall 2018.

		East Lansing			Mesick		
	Species/ Seed source	Tree rating[1]	Leader rating[2]	Survival (%)	Tree rating	Leader rating	Survival (%)
Check lots	Balsam	0.00	0.50	20.7	1.00	0.29	28.0
	Concolor	0.67	0.90	33.3	1.00	0.50	51.6
	Fraser	0.64	1.29	51.9	1.04	0.82	54.8
	Grand	0.79	1.38	44.8	0.52	0.36	93.3
	Korean	0.47	1.27	51.7	0.80	0.70	75.0
	Noble	-	-	0.0	1.20	1.69	53.3
	Nordmann	1.04	1.57	53.1	0.75	1.27	90.8
	Turkish	0.65	1.27	75.9	0.53	1.03	100.0
Trojan	Can	0.77	1.41	60.1	0.65	0.99	92.0
	Kazdagi	0.62	1.39	66.9	0.48	0.72	93.4
Turkish	Akyazi	0.80	1.42	52.7	0.53	1.25	93.7
	Bolu	0.67	1.43	73.3	0.40	1.16	98.2
	Karabuk	0.80	1.46	69.0	0.38	1.16	97.1

1. Tree rating: 0 = completely green, heathy; 1 = some browning or damage; 2= dead
2. Leader rating: 0 = normal central leader; 1 = leader from subtending lateral; 2 = multiple leaders

(Table 2). The lower survival in East Lansing is likely due to several factors including less snow cover, more mammal damage (primarily deer) and higher weed competition than at Mesick. At East Lansing, survival ranged from 0% for noble fir to 75.9% for the check-lot Turkish fir from Kintigh nursery. At Mesick, survival ranged from 28% for balsam fir to 100% for the check-lot Turkish fir. Among the CoFirGE accessions, Turkish fir from the Bolu provenance had the highest survival at both planting locations (98.2% at Mesick; 73.3% at East Lansing), while Trojan fir from Can had the lowest survival (92.0% at Mesick; 60.1% at East Lansing).

In fall 2018, we assessed overall tree condition and terminal leader status. Tree condition was rated on a scale of 0 to 2, where 0 indicated a green, vigorous tree; 1 indicated some needle discoloration or poor overall form, and 2 was dead. We assessed leader status as it became clear than many trees lacked dominant, central leaders due terminal bud abortion or browse damage. Both Trojan and Turkish fir break bud relatively early and late winter injury was also common (Fig. 4). We scored leader development on a 0 to 2 scale, where 0 indicated a dominant central leader arising from a whorl of buds, 1 indicated

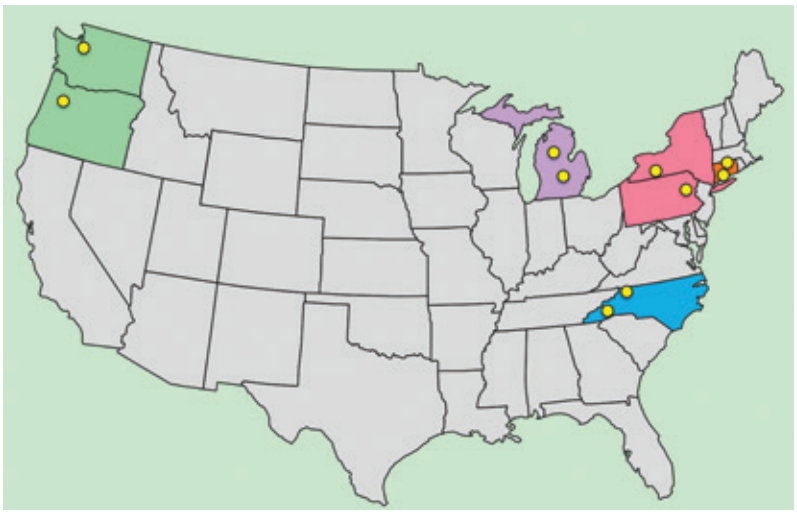

Figure 3. Location of CoFirGE test plantations in the U.S. (Image: John Frampton, NCSU)

Figure 4. Late frost damage in Trojan fir.

Figure 5. Rating codes for terminal leader development. 0 – strong central leader; 1 – leader(s) not from central bud, 2 – no terminal leader.

terminal leader(s) arising from lateral or below a whorl, and 2 indicated no leader(s) (Fig. 5). Balsam fir maintained the best tree condition rating and leader rating at East Lansing and had the best leader rating at Mesick. Grand fir had the best tree condition rating at Mesick. Among the CoFirGE accessions, the Kazdagi source of Trojan fir and the Bolu source of Turkish for had the best tree condition rating. At Mesick, the Kazdagi, Bolu and Karabuk seed sources had the best condition rating. All of the CoFirGE seed sources had poor leader development in East Lansing (leader rating 1.4 or higher), likely reflecting frequent deer browsing and late winter damage.

Height growth also varied among species and provenances. At East Lansing, balsam fir and Fraser fir trees had the greatest height growth six years after planting (Fig. 6). The Kazdagi provenance of Trojan fir had the greatest growth among CoFirGE sources at East Lansing. At Mesick, balsam fir and grand fir were the tallest trees; however, the Kazdagi source of Trojan fir and Karabuk source of Turkish fir has comparable growth rates (Fig. 7).

LOOKING AHEAD

The objective of the CoFirGE project is to evaluate the performance of the trees in each plantation through 2021, which would approximate a typical Christmas tree rotation cycle. Future assessments will include continued measurements of survival and bud-break as well as growth and other traits important for Christmas trees including form and needle retention. All data will ultimately be complied and analyzed to determine which populations of these species are best suited for use as Christmas trees in each region of the country.

NOTE: MSU Extension is hosting a winter webinar series "What's new in Christmas tree production" that will include an update from each of CoFirGE collaborator on Feb. 13, 2019. Google 'MSU Christmas tree research webinar' for more information and registration.

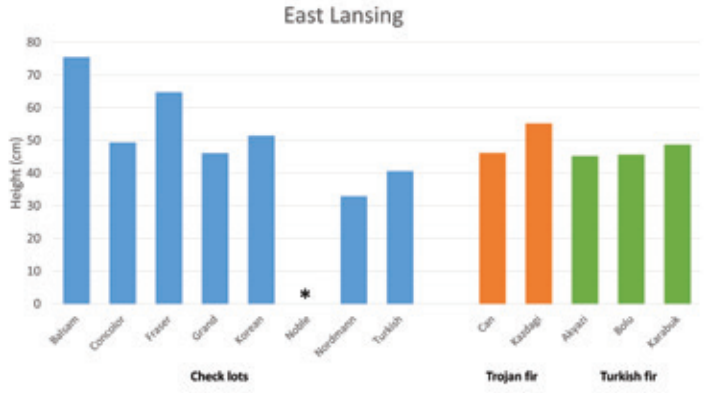

*Figure 6. Mean tree height for Turkish fir and Trojan fir provenances and CoFirGE check-lots. MSU Tree Research Center, East Lansing, MI, Fall 2018. *, no noble fir survived.*

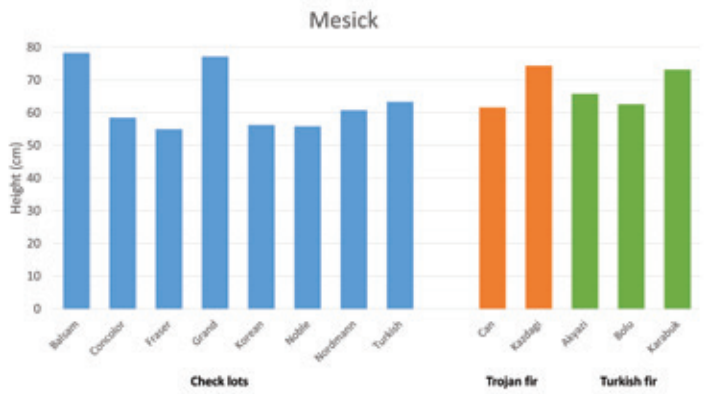

Figure 7. Mean tree height for Turkish fir and Trojan fir provenances and CoFirGE check-lots. Antioch Tree Farm, Mesick, MI, Fall 2018.

Acknowledgements

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CoFirGE PROJECT MEMBERS

North Carolina Christmas Tree Association
North Carolina State University

Pacific Northwest Christmas Tree Association
Oregon & Washington State Universities

Michigan Christmas Tree Association
Michigan State University

Connecticut Christmas Tree Association
Connecticut Agricultural Experiment Station

Pennsylvania Christmas Tree Growers Association
New York Christmas Tree Association
Penn State University

Danish Christmas Tree Growers Association
University of Copenhagen