UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE

in cooperation with

STATE AGRICULTURAL EXPERIMENT STATIONS

Results from the

UNIFORM OATS WINTER HARDINESS NURSERY

2012-2013

Compiled by

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This is a joint progress report of an investigation underway in the State Agricultural Experiment Stations and the Agricultural Research Service of the U. S. Department of Agriculture. It contains preliminary data which have not been sufficiently confirmed to justify general release; interpretations may be modified with additional experimentation. Confirmed results will be published through established channels. The report is primarily a tool for cooperators, their staff and those with special interest in agricultural research program development.

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CONTENTS

COOPERATING AGRICULTURAL EXPERIMENT STATIONS AND PERSONNEL

Country	State	AES Location	Personnel
USA	AR	Fayetteville	E. Mason
USA	IL	Lawrenceville	L. Phillippe
USA	NC	Laurel Springs/Waynesville	D. Marshall/M. Fountain
USA	TN	Knoxville	D. West
USA	LA	Baton Rouge	S. Harrison
USA	OK	Ardmore	M. Newell
Poland	Blonie	Plant Breeding and Acclimatization Ins.	B. Lapinski
Czech Republic	Kromeriz	Agricultural Research Institute	M. Kadlíková
Hungary	Martonvasar	Agric. Res. Inst. of Hungary Academy	O. Veisz
Austria	Edelhof	Saatzucht Edelhof	S. Berger & H. Hofbauer
Germany	Bad Vibel	Dottenfelderhof 1	B. Schmehe
UK	Wales	IBERS Aberystwyth University	S. Cowan
Canada	Saskatchewan	Oat Advantage	J. Dyck

DIGEST

NUMBER OF TESTS:	13 tests (6 US States, 7 foreign countries)	
NUMBER OF ENTRIES:	14	
EXPERIMENTAL DESIGN:	Single-row, 5-foot plot Two replications Randomized complete block	
DATA RECORDED:	Percent winter survival	
DATA NOT USED IN ANALYSIS:	Ardmore, OK	100% Survival
	Saskatchewan, Canada	0% Survival
	Fayetteville, AR	No Data
	Knoxville, TN	No Data
	Baton Rouge, LA	No Data
	Blonie, Poland	No Data
	Kromeriz, CR	No Data
	Wales, UK	No Data

COMMENTS:

- Analysis of markers assocated with winter hardiness was implemented beginning with the 2008-2009 nursery.
- All new oat lines will be evaluated with Simple sequence repeats (SSRs) associated with winter hardiness traits and continue to be to added to the report.

US STATE/COUNTRY	LOCATION	COOPERATORS' COMMENTS
Austria	Edelhof	Sowing on 28th of September, 2012. Long winter with lots of snow until the beginning of April.

Table 1. Entries in the 2012-2013 Uniform Oat Winter Hardiness Nursery.

Entry No.	Entry name	Pedigree	Yrs in Nursery	Contributors	
1	Fulgum (ck)	Cl 708	75		
2	Norline (ck)	Cl 6903	52		
3	Winter Turf (ck)	Cl 3296	72		
4	Wintok (ck)	Cl 3424	72		
5	NC11-1805	SS76-40 / NW10B / FL9708P37	1	Murphy	NC
6	NC11-1898	NC02-8005 / NW10B / FL9708P37	1	Murphy	NC
7	NC10-5051y	SC961246 / AR0258-7	1	Murphy	NC
8	NC10-5069y	SC961246 / Rodgers	1	Murphy	NC
9	NC02-8331y	NC93-2978/FL874S1G3//ARFOB3D	1	Murphy	NC
10	NC11-1655	SS76-40 // IL86-5698 / TX98D666	1	Murphy	NC
11	NC11-1413	FL98107-C3 // FL9708P37/ Caballo	1	Murphy	NC
12	NC11-1842	SS76-40 / Terral Trophy	1	Murphy	NC
13	NC11-1651	SS76-40 // IL86-5698 / TX98D666	1	Murphy	NC
14	NC08-2706N	TX980658 / NC97-8972N // Caballo	1	Murphy	NC

Top 10 ranked survival entries for 2012-2013

Rank	Ent No.	Entry	Pedigree		% Survival (across locations)
1	3	Winter Turf (ck)	Cl 3296		82
2	4	Wintok (ck)	Cl 3424		80
3	9	NC02-8331y	NC93-2978/FL874S1G3//ARFOB3D		78
4	5	NC11-1805	SS76-40 / NW10B / FL9708P37		75
5	12	NC11-1842	SS76-40 / Terral Trophy		75
6	11	NC11-1413	FL98107-C3 // FL9708P37/ Caballo		74
7	6	NC11-1898	NC02-8005 / NW10B / FL9708P37		73
8	2	Norline (ck)	Cl 6903		73
9	1	Fulgum (ck)	Cl 708		70
10	10	NC11-1655	SS76-40 // IL86-5698 / TX98D666		70
				LSD (0.05)	**8.7**

Table 2a. Winter Oat Survival (%) at Various Stations (sorted by entry number)

Ent. No.	Entry Name	Ranked Means	Means across loc	Martonvasar Hungary	Bad Vibel Germany	Edelhof Austria	Laurel Spring NC
1	Fulgum (ck)	9	70	68	90	22	100
2	Norline (ck)	8	73	71	100	32	90
3	Winter Turf (ck)	1	82	64	100	64	100
4	Wintok (ck)	2	80	63	95	61	100
5	NC11-1805	4	75	69	90	39	100
6	NC11-1898	7	73	60	95	39	100
7	NC10-5051y	12	66	46	90	39	90
8	NC10-5069y	14	65	58	90	32	80
9	NC02-8331y	3	78	69	100	43	100
10	NC11-1655	10	70	53	90	36	100
11	NC11-1413	6	74	57	100	39	100
12	NC11-1842	5	75	77	95	36	90
13	NC11-1651	13	66	70	85	7	100
14	NC08-2706N	11	66	43	90	32	100
	Average		72.3	62.0	93.6	37.3	96.4
	LSD (0.05)		8.7	9.5	18.4	31.3	16.9
	CV(%)		5.6	7.1	9.1	38.7	8.1

Table 2b. Winter Oat Survival (%) at Various Stations (sorted by rank)

Ent. No.	Entry Name	Ranked Means	Means across loc	Martonvasar Hungary	Bad Vibel Germany	Edelhof Austria	Laurel Spring NC
3	Winter Turf (ck)	1	82	64	100	64	100
4	Wintok (ck)	2	80	63	95	61	100
9	NC02-8331y	3	78	69	100	43	100
5	NC11-1805	4	75	69	90	39	100
12	NC11-1842	5	75	77	95	36	90
11	NC11-1413	6	74	57	100	39	100
6	NC11-1898	7	73	60	95	39	100
2	Norline (ck)	8	73	71	100	32	90
1	Fulgum (ck)	9	70	68	90	22	100
10	NC11-1655	10	70	53	90	36	100
14	NC08-2706N	11	66	43	90	32	100
7	NC10-5051y	12	66	46	90	39	90
13	NC11-1651	13	66	70	85	7	100
8	NC10-5069y	14	65	58	90	32	80
	Average		72.3	62.0	93.6	37.3	96.4
	LSD (0.05)		8.7	9.5	18.4	31.3	16.9
	CV(%)		5.6	7.1	9.1	38.7	8.1

Table 3. Uniform Oats Winter Hardiness Nursery Under Controlled Environment Freeze Test

Entry #	Entry Name	Survival Rating[1]	% Survival[2]
1	Fulgum (ck)	0.5	23
2	Norline (ck)	2.8	80
3	Winter Turf (ck)	1.6	58
4	Wintok (ck)	2.5	65
5	NC11-1805	1.7	63
6	NC11-1898	1.1	48
7	NC10-5051y	1.6	65
8	NC10-5069y	1.5	58
9	NC02-8331y	1.9	65
10	NC11-1655	1.3	50
11	NC11-1413	1.6	63
12	NC11-1842	1.5	55
13	NC11-1651	1.1	45
14	NC08-2706N	1.8	68
	Average	1.6	57
	LSD (5%)	0.4	9.8
	CV	11	7.9

Parameters:

-2 reps/10 plants per rep planted in cone-tainers (Livingston et al. 2005, Crop Science, 45:1545-1558)
-5 weeks at 13°C; 12 hours light/dark period; 400µmole light intensity
-3 weeks at 3°C; 12 hours light/dark period; 350µmole light intensity
-3 days @ -3°C in the dark (subzero acclimation)
-Whole plants were frozen @ 1°C/hour to -12°C for 3 hours
-Thawed @ 2°C/hour to 3°C
-Plants were watered once with 0.001% (v/v) Vitavax fungicide solution
-Plants were allowed to recover for 3 weeks in the greenhouse
-Whole Plants were rated for regrowth after 21 days by visually assessing leaves and roots.

[1]Rating:
0 = Completely dead
1 = 1 survived (green) shoot or 1 primary root
2 = 1 or 2 survived (green) shoots or 1 survived shoot and 1 or 2 primary roots
3 = 1 or 2 survived shoots with developed roots (primary and secondary roots)
4 = 95% survived shoots with well developed roots
5 = 100% survived with very little or no sign of freeze damage; same as unfrozen plants

[2]Survival (%):
-50% of plants with rating of 1plus all plants rated >2 divided by total number of plants frozen multipled by 100

Table 4. Markers Associated with Winter Hardiness Traits

	SSR Marker	AM2	AM102	AM270S-1	HVM20	JAO4042	JAO4234a	JAO4234b	JAO4636	VRN1	xncs15-3	AME23	AME178	AME184a	AME184b	
	Associated Traits	RS, LS, CFT	RS, LS, CFT	FT, TR, LS, CFT	LS, RS, CFT, TR	TR	VRN, RS, LS, CFT	CFT	CFT	VRN	CFT, TR	MAT, LPPD, SPPD, VRN, NO-VRN, MAT-VLD, RS, LS, CFT	RS	CFT	WFS, MAT, LPPD, SPPD, VRN, NO-VRN, MAT-VLD	Number of significant alleles
	Fragment of interest	164	220	206	142	262	260	283	286	390	232	263	182	190	193	
Entry No.	Entry Name															
1	Fulghum (ck)	yes	no	no	no	no	no	no	no	no	no	no	no	yes	yes	3
2	Norline (ck)	no	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	no	yes	10
3	Winter Turf (ck)	yes	yes	no	no	yes	no	no	no	no	no	yes	no	no	yes	5
4	Wintok (ck)	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes*	no	no	yes	10
5	NC11-1805	yes	yes	yes	yes	yes	no	no	yes	no	yes	no	no	no	yes	8
6	NC11-1898	no	yes	yes	yes	yes	no	no	no	no	yes	yes	no	no	yes	7
7	NC10-5051y	-	yes	yes	yes	yes	no	no	yes*	no	yes	no	no*	no	yes	6
8	NC10-5069y	-	yes	yes	yes	yes	no	no	yes	no	yes	no	no	no	no	6
9	NC02-8331y	no	yes	yes	yes	yes	no	no	no	no	yes	no	no	no	yes	6
10	NC11-1655	yes	yes	yes	yes	yes	no	no	no	no	yes	no	no	no	yes	7
11	NC11-1413	no	yes	yes	yes	yes	no	no	no	no	yes	yes	no	no	yes	7
12	NC11-1842	-	yes	yes	yes	yes	no	no	no	no	yes	no	no	no	yes	6
13	NC11-1651	no	yes	yes	yes	yes	no	no	no	no	yes	no	no	no	yes	6
14	NC08-2706N	no	yes	yes	yes	yes	no	no	no	no	yes	no	no	no	yes	6

WFS = Winter Field Survival
FT = Freeze Tolerance
TR = Translocation 7C-17
MAT = Maturity
LPPD = Long Photoperiod
SPPD = Short Photoperiod
MAT-VLD = Maturity in vernalized long day treatment
HD = Heading date
RS = Root score
LS = Leaf Score
CFT = Crown Freeze Tolerance
VRN = Vernlization
NO-VRN = No Vernlization

* Results differ from previous testing and may represent variation within these lines using these markers.