South Dakota State University
College of Agriculture, Food and Environmental Sciences

South Dakota State University Extension
South Dakota Agricultural Experiment Station at SDSU

2021 South Dakota Organic Oat Variety Results

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2021 Organic Oat Variety Trial – Beresford

Cooperator: SDSU Southeast Research Farm, Peter Sexton, Manager
Location: 43.042841, -96.897525
Soil Type: Egan-Clarno-Tetonka complex, 0 to 2 percent slopes
Previous crop: Sundangrass Albert Lea 500 and Sunn Hemp Albert Lea VNS
Row spacing: 7”
Seeding Rate: 1.6 million PLS/acre
Under seeding: Medium red clover
Date seeded: 03/31/21
Date Harvested: 07/12/21

2021 Organic Oat Variety Trial – Madison

Cooperator: Charlie Johnson
Location: 43.87414, -97.12955
Soil Type: Egan-Wentworth complex, 2 to 6 percent slopes
Previous crop: Soybeans
Row spacing: 7”
Seeding Rate: 1.6 million PLS/acre
Under seeding: Alfalfa
Date seeded: 04/06/21
Date Harvested: 07/19/21

2021 Organic Oat Variety Trial – Brookings

Cooperator: SDSU Foundation Seed Manager, Jack Ingemansen
Location: 44.325311, -96.775407
Soil Type: Vienna-Brookings complex, 0 to 2 percent slopes
Previous crop: Winter wheat
Row spacing: 7”
Seeding Rate: 1.6 million PLS/acre
Under seeding: No
Date seeded: 04/21/21
Date Harvested: 07/28/21

2021 Organic Oat Variety Trial – NDSU Carrington Research Extension Center

Cooperator: NDSU Carrington, Steve Zwinger
Location: 47.51219078, -99.12093167
Soil Type: Heimdal-Emrick Soil Series 1-3 Percent Slope
Previous crop: cover crop (field pea, lentil, turnip and dwarf Essex rape)
Row spacing: 7”
Seeding Rate: 1.6 million PLS/acre
Under seeding: No
Date seeded: 04/27/21
Date Harvested: 08/02/21

S-0002-02

Description

Thirty oat experimental lines and released varieties were evaluated under organic management conditions at four locations (Beresford, Brookings, and Madison in South Dakota, and Carrington in North Dakota). The list of entries, along with their agronomic characteristics are presented in Table 1. Average test weights and grain yields collected from organic trials in 2021 are reported in Table 2a. Performance over multiple year (2019-2021) is reported for Beresford in Tables 2b. Grain characteristics and milling quality (averaged over all locations) are reported in Table 3.

In 2021, growing conditions were dry at all locations. For Madison, entries were not significantly ($p < 0.05$) different from each other for yield and therefore yield and test weight data are not reported. When averaged over the three locations (Beresford, Brookings, and Carrington), varieties Newburg, Excel, Hayden, Deon, Goliath, Warrior, Souris, MN Pearl, Shelby 427, Natty, and Reins were the highest yielding varieties. Among this group, Goliath, Reins, and Shelby 427 exhibited the highest test weight. For Beresford, when data was averaged over three years (2019-2021), Sumo was in the top yielding group and was among the entries with the highest test weight.

For the second year, the effect of four seeding rates (1.2, 1.6, 1.9, and 2.3 million seeds/acre) was evaluated using three early-maturing oat varieties (Sumo, Saddle, and Reins). The effect of seeding rate on grain yield and test weight were not significant for any of the three varieties (Figure 1a and Figure 2a). However, varieties were significantly different from each other for grain yield, with Reins having significantly higher yield than Saddle and Sumo. These varieties were not significantly different from each other for test weight. Unlike for the study conducted in 2020, the effect of seeding rates on ground cover, yield, and test weight wasn't significant (Figure 1b and 2b). This may be due to the stress caused by the dry weather conditions in 2021. This study will be repeated in 2022.

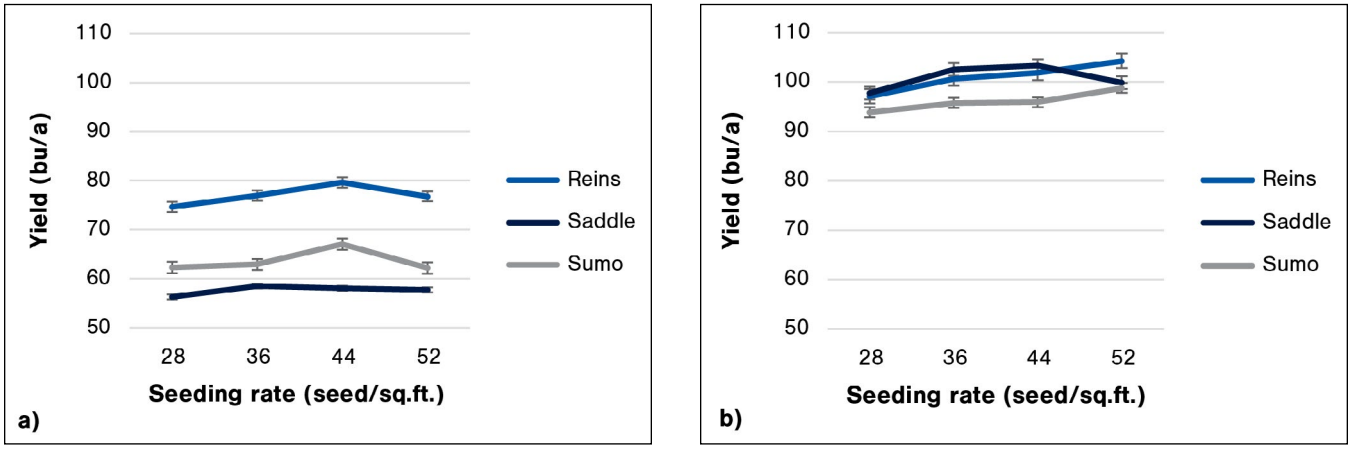

Figure 1. Effect of seeding rate on oat grain yield for three cultivars evaluated under organic management practices at Madison, SD in 2021 (a) and 2020 (b).

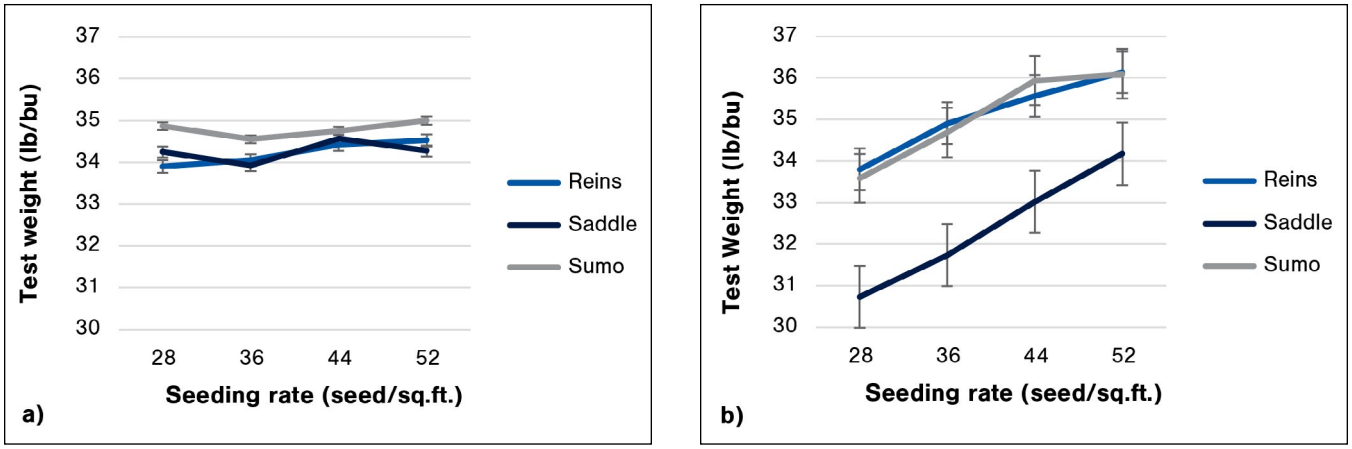

Figure 2. Effect of seeding rate on oat test weight for three cultivars evaluated under organic management practices at Madison, SD in 2021 (a) and 2020 (b).

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Table 1. List of varieties and experimental lines evaluated under organic managememt practices in 2021.

Entry	Origin†	Year of release¥	Relative Heading‡ (days)	Relative Height‡ (inches)	Lodging § (%)	Crown rust severity (%)
Antigo	WI	2017	1	7	33	30
Badger	WI	2010	1	5	62	57
Betagene	WI	2014	3	7	30	13
Deon	MN	2013	6	11	5	18
Esker2020	WI	2019	2	7	75	23
Excel	IN	2006	3	7	89	43
Goliath	SD	2012	6	13	96	60
Hayden	SD	2014	5	7	96	60
Jerry	ND	1994	2	8	99	60
Leggett	CAN	2005	7	6	0	12
MN Pearl	MN	2018	6	7	22	13
Natty	SD	2014	2	10	97	60
Newburg	ND	2011	5	12	98	40
ORe3541m	CAN	Exp	5	5	–	–
Reins	IL	2015	1	0	0	43
Rockford	ND	2009	6	10	93	55
Rushmore	SD	2019	3	8	45	20
Saber	IL	2010	1	5	25	57
Saddle	SD	2017	1	4	0	18
SD Buffalo	SD	2021	3	6	2	13
SD160067	SD	Exp	2	5	12	22
SD160070	SD	Exp	2	10	17	8
SD170463	SD	Exp	6	10	45	27
SD170935	SD	Exp	7	15	–	–
SD171469	SD	Exp	2	7	–	–
SD180580	SD	Exp	4	6	–	–
Shelby 427	SD	2009	2	9	95	57
Souris	ND	2006	5	5	99	63
Sumo	SD	2016	0	6	5	13
Warrior	SD	2018	2	5	2	18

† CAN - Canada, IL - Illinois; IN - Indiana; MN - Minnesota, ND - North Dakota, SD - South Dakota, WI – Wisconsin.
‡ Days to heading compared to Sumo (57 days) and height in inches compared to Reins (27 inches) calculated over locations in 2021.
§ Lodging severity in Madison 2020. 0%: no lodging - 100% entire plot flat.
¶ Crown rust severity: field ratings from Madison 2020, 0%: no crown rust pustules - 100%: flag leaves completely covered with pustules.

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Table 2a. Average yield and test weight in the 2021 organic oat variety trial. Entries are sorted by overall yield.

Entry	Beresford		Brookings		NDSU		Overall	
	Test Wt (lb/bu)	Yield (bu/a)	Test Wt (lb/bu)	Yield (bu/a)	Test Wt (lb/bu)	Yield (bu/a)	Test Wt (lb/bu)	Yield (bu/a)
Newburg	26.60	85.44	31.36	**83.83**	**36.86**	**119.40**	31.61	**96.23**
Goliath	**30.06**	84.30	30.63	**82.73**	**37.66**	**116.96**	32.79	**94.67**
Hayden	**28.96**	85.21	27.89	74.73	**35.39**	**121.78**	30.75	**93.91**
SD160070	**29.56**	78.68	30.29	**78.79**	**35.98**	**120.72**	31.95	**92.73**
Excel	**29.23**	**92.21**	34.79	**80.51**	33.46	105.23	32.50	**92.65**
ORe3541m	24.43	72.17	29.36	76.26	**36.20**	**124.62**	30.00	**91.02**
Deon	25.50	61.24	31.03	**88.56**	**36.99**	**120.64**	31.17	**90.15**
Esker2020	24.86	85.80	32.49	**86.00**	33.00	105.41	29.70	**90.14**
Souris	28.26	76.73	30.63	77.06	**36.41**	**114.93**	31.77	**89.57**
Reins	**30.80**	**99.64**	**37.96**	**80.05**	30.58	87.87	**33.12**	**89.19**
Warrior	25.80	76.70	34.93	**81.32**	**36.80**	109.48	32.51	**89.17**
SD160067	27.70	**90.85**	30.76	**80.86**	32.67	94.81	30.38	**88.84**
SD170935	27.66	60.27	31.89	76.77	**39.39**	**127.95**	**33.12**	**88.33**
Natty	**30.33**	**97.31**	33.99	**86.14**	29.33	80.65	31.22	**88.03**
MN Pearl	28.16	70.68	33.49	**81.35**	34.04	111.73	31.90	**87.92**
Shelby 427	**30.13**	80.10	**36.39**	**83.24**	**37.81**	100.40	**34.78**	**87.91**
SD180580	**30.00**	75.45	**35.66**	**80.44**	35.03	104.08	**33.56**	86.66
SD170463	**30.00**	69.82	**35.96**	**78.99**	**37.98**	105.64	**34.65**	84.82
Saber	24.96	81.98	29.33	74.03	33.18	98.42	29.16	84.81
Badger	27.90	**93.15**	30.66	**78.93**	28.05	78.95	28.97	84.27
Betagene	23.50	78.55	28.79	**78.25**	28.75	94.14	27.02	83.64
SD150012	28.16	75.73	29.79	73.95	**36.55**	104.32	30.94	82.85
Rushmore	**29.96**	78.06	34.53	77.39	32.76	91.38	32.42	82.28
SD171469	28.53	66.16	**39.39**	**85.94**	33.19	93.62	**33.71**	81.91
Leggett	21.43	53.57	32.56	75.62	**35.96**	101.65	31.10	79.88
Saddle	26.26	77.42	31.33	65.16	32.23	93.97	29.94	78.85
Rockford	23.23	51.85	26.37	70.66	34.22	95.82	29.61	78.74
Antigo	**30.23**	**85.94**	**36.93**	69.89	26.14	79.78	31.10	78.54
Sumo	**29.76**	81.26	34.03	76.36	25.64	74.97	29.78	77.05
Jerry	27.60	67.75	31.63	64.73	31.18	83.94	30.14	72.14
Trial average	27.65	77.80	32.49	78.28	33.78	102.11	31.38	86.23
C.V. %	4.07	10.16	6.96	8.52	7.63	9.85	6.82	10.53
LSD (0.05)	1.91	13.56	3.79	10.98	4.1	15.29	2.03	8.65

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Table 2b. Average yield and test weight in the organic oat variety trial performed in Beresford from 2019 to 2021. Entries are sorted by overall yield.

Entry	Beresford						Overall	
	2021		2020		2019		2019-2021	
	Test Wt (lb/bu)	Yield (bu/a)	Test Wt (lb/bu)	Yield (bu/a)	Test Wt (lb/bu)	Yield (bu/a)	Test Wt (lb/bu)	Yield (bu/a)
SD160067	27.70	**90.85**	37.4	**80.2**	35.6	**101.7**	33.54	**90.89**
Sumo	**29.76**	81.26	38.5	69.1	**37.8**	**85.7**	**35.30**	**78.68**
Reins	**30.80**	**99.64**	38.1	65.7	34.6	70.6	34.50	78.64
MN Pearl	28.16	70.68	36.8	74.2	35.5	**88.7**	33.48	77.85
Badger	27.90	**93.15**	36.2	**74.7**	35.3	63.5	33.14	77.12
SD150012	28.16	75.73	36.7	67.1	**37.6**	83.2	34.14	75.33
Natty	**30.33**	**97.31**	38.0	**70.3**	35.9	57.2	**34.74**	74.93
Antigo	**30.23**	**85.94**	**39.7**	68.6	**39.0**	69.4	**36.32**	74.63
Warrior	25.80	76.70	35.4	70.1	**36.1**	71.4	32.43	72.73
Goliath	**30.06**	84.30	36.8	**69.6**	32.8	63.9	33.22	72.61
Betagene	23.50	78.55	34.6	68.2	32.8	70.0	30.30	72.27
Rushmore	**29.96**	78.06	**38.8**	66.1	34.9	71.9	34.56	72.00
Saddle	26.26	77.42	36.8	63.4	**36.7**	72.8	33.26	71.21
Excel	**29.23**	**92.21**	36.7	**71.7**	26.6	44.8	30.87	69.57
Deon	25.50	61.24	35.8	**72.6**	35.1	71.6	32.12	68.48
Newburg	26.60	85.44	34.4	71.5	30.4	39.9	30.47	65.63
Hayden	**28.96**	85.21	35.8	60.3	30.1	47.5	31.64	64.34
Shelby 427	**30.13**	80.10	36.2	57.3	33.3	46.8	33.23	61.39
Leggett	21.43	53.57	34.6	50.6	35.2	70.3	30.46	58.18
Saber	24.96	81.98	36.7	55.9	**36.9**	35.6	32.86	58.03
Souris	28.26	76.73	34.4	67.6	31.3	25.5	31.32	56.61
Jerry	27.60	67.75	35.5	61.2	29.3	31.1	30.78	53.37
Rockford	23.23	51.85	33.9	52.1	26.4	26.4	27.67	43.50
Esker2020	24.86	85.80	33.7	67.4	–	–	–	–
ORe3541m	24.43	72.17	–	–	–	–	–	–
SD160070	29.56	78.68	36.5	59.2	–	–	–	–
SD170463	**30.00**	69.82	38.5	66.1	–	–	–	–
SD170935	27.66	60.27	–	–	–	–	–	–
SD171469	28.53	66.16	–	–	–	–	–	–
SD180580	**30.00**	75.45	–	–	–	–	–	–
Trial average	27.7	77.8	36.4	66.2	33.9	61.3	32.8	69.0
C.V. %	4.1	10.2	1.6	9.4	5.9	16.1	4.8	12.3
LSD (0.05)	1.91	13.56	0.9	10.9	3.06	16.81	1.52	8.12

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Table 3. Grain quality and milling characteristics for oat varieties and breeding lines evaluated in the 2021 organic variety trial (averaged over four locations).

Entry	Plump (%)	Mid (%)	Thin (%)	1000 Kernel Weight (g)	Groat (%)	Groat Protein (%)	Groat Beta-Glucan (%)	Groat Oil (%)
Antigo	7.2	72.1	20.6	25.9	68.9	22.3	5.1	5.9
Badger	32.2	57.8	9.9	31.7	64.7	18.6	4.6	4.6
Betagene	44.9	48.7	6.4	33.6	67.3	18.1	5.2	4.3
Deon	12.7	75.8	11.4	31.8	70.8	17.7	4.3	5.2
Esker2020	29.9	55.8	14.4	30.1	69.8	18.4	5.0	4.1
Excel	34.4	58.7	6.8	31.9	68.3	17.3	4.3	4.0
Goliath	33.9	55.8	10.2	30.9	73.6	17.8	4.4	5.0
Hayden	41.0	53.0	5.9	35.7	72.4	17.4	4.3	5.7
Jerry	27.1	64.7	8.1	31.8	69.2	19.2	4.4	3.7
Leggett	22.9	65.5	11.5	32.8	69.0	18.0	4.8	4.7
MN Pearl	31.6	57.7	10.6	33.4	76.1	16.7	4.4	5.4
Natty	33.1	52.1	14.9	30.2	69.6	17.7	4.1	4.0
Newburg	31.7	56.5	11.8	30.5	70.0	18.1	5.1	5.5
ORe3541m	52.7	39.0	8.1	30.6	70.7	17.5	4.7	3.5
Reins	20.0	61.8	18.2	27.9	69.8	19.1	4.7	4.6
Rockford	27.5	61.8	10.7	29.6	70.1	17.4	4.2	5.8
Rushmore	31.5	56.2	12.2	29.8	69.6	19.7	4.6	4.7
Saber	25.6	63.1	11.3	28.2	66.1	19.3	4.4	4.1
Saddle	10.7	79.5	9.8	27.6	70.2	18.3	4.3	4.0
SD150012	22.5	66.9	10.6	30.9	68.8	18.7	4.3	5.5
SD160067	24.6	64.4	10.9	32.4	69.4	18.3	4.7	4.2
SD160070	42.0	52.3	5.6	36.2	68.8	18.7	5.0	4.5
SD170463	35.0	60.2	4.9	32.5	70.5	17.8	4.5	4.2
SD170935	38.3	54.5	7.2	32.6	70.0	16.1	4.4	5.9
SD171469	35.4	55.0	9.6	30.3	69.5	17.1	4.1	4.1
SD180580	28.2	62.0	9.8	30.2	71.4	17.1	4.2	4.9
Shelby 427	20.5	69.2	10.3	29.7	71.5	18.6	4.4	5.1
Souris	19.3	64.2	16.4	28.8	73.3	17.9	4.8	4.4
Sumo	30.8	58.7	10.5	31.4	69.0	19.3	4.1	4.1
Warrior	14.2	75.8	9.9	31.0	71.6	18.6	4.7	5.0
Trial average	28.7	60.6	10.6	31.0	70.0	18.2	4.5	4.7
C.V. %	30.9	13.7	35.8	6.7	3.6	4.8	5.3	7.0
LSD (0.05)	12.51	11.75	5.38	2.93	3.58	1.25	0.34	0.46

Recommendations

➔ **Choosing a variety for organic oat grain production is an important management decision for successful organic oat production.**

➔ **Resistance to crown rust is necessary for areas where the fungus is prevalent such as in the eastern part of South Dakota.**

Crown rust is the most damaging disease of oats in South Dakota. When conditions are favorable to the development of the crown rust pathogen, severe infections can develop quickly in susceptible cultivars and can result in significant yield loss, severe lodging, and grain with low test weight and poor quality. Because evolving races of crown rust can overcome the resistance of older varieties, it is important to look at recent data when selecting a variety with good level of resistance to crown rust.

➔ **When marketing organic grain to the milling industry, choosing varieties with high test weight and plump kernels is necessary to ensure that the grain produced meet the specification of the industry.**

Oat varieties differ significantly for test weight and kernel plumpness. For example, over three years of testing in Beresford, there was a difference in test weight of up to 8.5 lb/bu between varieties. In a year like 2021, where test weight was low in several areas of the state due to heat and/or drought stress, planting a variety with high test weight can be very important to meet the specifications of the milling industry.

➔ **Multiple years of yield data near your area should be considered when choosing a variety.**

Grain yield can vary widely based on environmental conditions. To identify a variety with stable performance it is necessary to look at grain yield data over multiple years.

➔ **To optimize the plant population, it is recommended to adjust the seeding rate based on the thousand kernel weight.**

Varieties can range widely for thousand kernel weight. For example, in our trial (Table 3), the thousand kernel weight ranges from 25.9 g for Antigo to 35.7 g for Hayden.

Acknowledgement

This research is supported by **General Mills Foundation**. The overall goal of the project is to identify and develop varieties that will increase profits for farmers while improving soil health by incorporating small grains into crop rotations. We also wish to thank **Charlie Johnson** for providing access to his organic certified land.