



MONTANA
STATE UNIVERSITY

College of
AGRICULTURE &
MONTANA AGRICULTURAL
EXPERIMENT STATION

PROJECT TITLE:

2020 STATEWIDE DURUM VARIETY TRIALS

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 - Dr. Linda Dykes, USDA-ARS, Fargo, ND
- Funding provided by the Montana Wheat and Barley Committee and the U.S. Wheat and Barley Scab Initiative.

OBJECTIVE:

To test advanced experimental durum lines for agronomic and quality traits relative to currently grown cultivars under Montana growing conditions.

METHODS:

In 2020, 19 experimental durum lines developed at MSU and 11 elite durum varieties were tested under eight different environments across Montana. Experimental lines developed at MSU carry genetic markers associated with reduced cadmium accumulation and/or a licensed gene that increases pasta firmness (Table 1). Durum varieties tested include releases from North Dakota State University, University of Saskatchewan-Canadian Crop Development Center, Montana State University, and Westbred (Table 1). Dryland experiments were grown on-station at Montana Agriculture Experiments Stations (MAES) in Bozeman, MT (MSU-Post Agronomy Farm), Havre, MT (MSU-NARC), Sidney, MT (MSU-EARC), Huntley, MT (MSU-SARC), and Moccasin, MT (MSU-CARC). A dryland experiment was grown in Conrad, MT by 2nd Nature Research due to lack of available WTARC staff in 2020 and irrigated trials were grown on-station in Bozeman, MT (MSU-Post Agronomy Farm) and Sidney, MT (MSU-EARC). There were three off-station experiments planted in Eastern Montana (Poplar, Dagmar, and Wibaux) by EARC staff and three off-station experiments planted in North Central Montana (Loring, Turner and Chester) by NARC staff. Off-station trials did not encompass all experimental lines and consisted primarily of released varieties. There were three replicates of each line/variety grown at each location in either a randomized complete block design or an alpha-lattice design to determine statistical differences and seed was treated with CruiserMaxx Vibrance for Cereals® (Syngenta) (5 fl oz/100 lb). Cooperators provided agronomic data such as plant height, heading date, pest pressure, grain protein content, grain test weight, and grain yield. On-station grain sub-samples from the three replicates per line per location were bulked and submitted to Dr. Linda Dykes (USDA-ARS, Fargo, ND) for analysis of seed traits, milling and semolina quality, and mixing strength.

Overall statewide agronomic performance for 2020 on-station trials can be found in Table 1. Agronomic performance for 2020 on-station trials separated by environment is presented in Tables 2 (irrigated) and 3 (dryland). Agronomic data for individual 2020 on-station trials is found in Tables 4-11 and data for off-station trials is found in Tables 12-18. No data is presented for the Wibaux off-station location. Fusarium head blight evaluations conducted by Dr. Crutcher at EARC are presented in Table 19. Overall seed quality and milling data is summarized in Table 20 and overall semolina quality in Table 21.

Table 1. Agronomic Data All On-station 2020 Durum Variety Trials (n=8).

Cultivar	Source¹	Yield² bu/ac	Test Weight lb/bu	Protein³ %	Plant Height inch	Heading Date Julian
Mountrail	NDSU	77.3*	61.3	14.3	35.2	179.2
Grenora	NDSU	72.8*	61.4	14.5	33.1	178.5
Divide	NDSU	74.3*	61.8	14.5	35.8	179.1
Tioga	NDSU	74.2*	61.7	14.7	37.6	179.6
Carpio	NDSU	76.0*	60.9	14.6	35.4	180.6
Joppa	NDSU	74.7*	61.8	14.2	35.9	179.2
ND-Riveland [‡]	NDSU	75.0*	61.3	14.8	36.8	179.7
ND-Grano [‡]	NDSU	77.1*	62.0	14.6	34.8	180.5
Alzada	Westbred	68.8	61.1	14.3	28.5	175.1
MTD18155	MSU	74.0*	61.0	14.9	31.8	178.9
CDC-Vivid [‡]	CDC	73.6*	61.4	15.3*	35.1	179.5
MTD16001 ⁺	MSU	72.8*	60.7	14.1	34.3	179.2
MTD16002 [‡]	MSU	77.5**	61.0	14.6	37.4	180.4
Lustre ^{††}	MSU	77.1*	60.4	14.8	35.9	179.8
MTD18213	MSU	75.5*	59.7	15.1*	37.0	181.0
MTD18486 [‡]	MSU	77.1*	61.1	14.6	37.1	182.8*
MTD18413 [‡]	MSU	74.8*	61.3	15.1*	35.2	178.6
MTD18348 [‡]	MSU	77.4*	61.3	14.7	37.5	180.9
MTD18091	MSU	74.1*	61.2	14.5	35.6	180.5
MTD18430	MSU	71.1	59.4	14.8	39.9**	183.1**
MTD18179 [‡]	MSU	73.0*	59.6	15.2*	34.1	178.5
MTD18172	MSU	76.8*	62.1	15.1*	35.1	180.7
MTD18067	MSU	75.7*	60.7	14.4	35.4	179.6
MTD18381 [‡]	MSU	66.4	60.8	15.0	33.5	177.2
MTD18181	MSU	66.9	60.7	15.5**	36.9	182.4*
MTD18256 [‡]	MSU	75.4*	61.0	15.2*	37.7	181.6
MTD18217	MSU	74.6*	60.8	14.7	37.8	182.6*
MTD18266 [‡]	MSU	76.7*	61.8	15.3*	36.5	181.5
MTD18148	MSU	74.2*	61.1	14.4	26.0	177.8
MTD18313	MSU	75.9*	62.8**	14.4	27.3	175.4
Average	-	74.4	61.1	14.7	35.0	179.8
LSD (p=0.05)	-	5.1	0.6	0.4	1.4	0.8
Prob > F	-	<0.001	<0.001	<0.001	<0.001	<0.001
CV(%)	-	7.0	1.0	3.0	4.1	0.4

[‡]Low cadmium accumulation gene.

[†]Pasta firmness gene.

¹NDSU-North Dakota State University, CDC-University of Saskatchewan Crop Development Center, MSU-Montana State University.

²Grain yield reported on a 13% moisture basis.

³Grain protein reported on a 12% moisture basis.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 2. Agronomic Data All Irrigated 2020 Durum Variety Trials (n=2).

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height inch	Heading Date Julian
Mountrail	122.2*	63.5*	13.7	39.6	181.4
Grenora	111.3	63.3*	14.2	36.9	180.9
Divide	117.6*	63.7*	14.2	39.8	182.2
Tioga	116.2*	63.6*	14.1	41.6	181.8
Carpio	123.0*	63.7*	14.0	40.2	182.5
Joppa	118.4*	63.8*	13.7	39.6	181.4
ND-Riveland	116.7*	63.5*	14.1	42.2*	181.6
ND-Grano	126.5**	64.0**	14.0	38.7	182.2
Alzada	100.0	62.1	14.1	29.3	177.7
MTD18155	111.9	62.4	14.6*	34.2	181.2
CDC-Vivid	111.1	63.1*	15.0*	38.2	182.2
MTD16001	116.6*	62.5	13.4	37.1	181.5
MTD16002	117.9*	62.9*	14.3	40.7	182.7
Lustre	117.5*	62.6	14.4*	39.3	182.0
MTD18213	124.7*	62.9*	14.1	42.5*	182.8
MTD18486	122.7*	63.5*	13.5	41.8*	184.8*
MTD18413	116.3*	63.0*	15.0*	39.8	181.7
MTD18348	115.9*	63.7*	14.1	42.9*	183.7*
MTD18091	118.1*	63.9*	13.7	39.7	182.5
MTD18430	109.9	62.0	14.2	44.7**	184.8**
MTD18179	112.1	61.9	14.4*	38.2	181.2
MTD18172	119.9*	63.8*	14.7*	38.9	183.7*
MTD18067	122.1*	62.6	13.9	39.1	181.7
MTD18381	102.2	62.4	15.0**	36.8	179.7
MTD18181	101.6	62.6	15.0*	40.2	184.7*
MTD18256	116.8*	63.1*	14.4*	43.1*	183.8*
MTD18217	122.8*	62.9*	14.1	43.7*	184.2*
MTD18266	121.8*	63.2*	14.8*	41.5	184.0*
MTD18148	111.6	62.5	14.1	28.7	179.3
MTD18313	111.5	63.6*	14.3	29.5	178.5
Average	115.9	63.0	14.2	38.9	182.1
LSD (p=0.05)	12.3	1.1	0.7	3.0	1.3
Prob > F	0.009	0.011	<0.001	<0.001	<0.001
CV%	5.2	0.9	2.3	3.8	0.4

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 3. Agronomic Data All On-station Dryland 2020 Durum Variety Trials (n=6).

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height inch	Heading Date Julian
Mountrail	62.3*	60.6	14.6	33.7	178.4
Grenora	60.0*	60.8	14.6	31.9	177.6
Divide	59.8*	61.1	14.6	34.4	177.9
Tioga	60.2*	61.1	14.9	36.2	178.7
Carpio	60.4*	60.0	14.8	33.8	179.9
Joppa	60.1*	61.2	14.4	34.7	178.3
ND-Riveland	61.2*	60.6	15.1	35.0	179.0
ND-Grano	60.6*	61.3	14.8	33.5	179.8
Alzada	58.4	60.7	14.3	28.2	174.1
MTD18155	61.4*	60.6	15.0	31.0	178.0
CDC-Vivid	61.2*	60.9	15.4*	34.1	178.5
MTD16001	58.2	60.1	14.3	33.4	178.2
MTD16002	64.0*	60.4	14.7	36.3	179.4
Lustre	63.6*	59.7	14.9	34.8	178.9
MTD18213	59.0	58.7	15.4*	35.2	180.3
MTD18486	61.9*	60.3	15.0	35.5	182.0*
MTD18413	60.9*	60.7	15.2*	33.7	177.4
MTD18348	64.5**	60.5	14.9	35.7	179.8
MTD18091	59.4*	60.3	14.7	34.2	179.8
MTD18430	58.2	58.6	15.0	38.3**	182.4**
MTD18179	59.9*	58.8	15.4*	32.7	177.4
MTD18172	62.4*	61.5	15.3*	33.9	179.6
MTD18067	60.3*	60.0	14.6	34.1	178.7
MTD18381	54.5	60.3	15.0	32.5	176.2
MTD18181	55.4	60.1	15.7**	35.8	181.5*
MTD18256	61.6*	60.4	15.5*	35.9	180.8
MTD18217	58.6	60.1	14.9	35.8	182.0*
MTD18266	61.7*	61.3	15.5*	34.9	180.5
MTD18148	61.8*	60.6	14.5	25.1	177.2
MTD18313	64.0*	62.6**	14.5	26.6	174.2
Average	60.5	60.5	14.9	33.7	178.9
LSD (p=0.05)	5.1	0.6	0.5	1.5	1.0
Prob > F	0.043	<0.001	<0.001	<0.001	<0.001
CV%	7.4	0.9	3.2	3.9	0.4

¹Grain yield reported on a 13% moisture basis.²Grain protein reported on a 12% moisture basis.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 4. Agronomic Data Bozeman Irrigated 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Stand³ %	Plant Height Inches	Heading Date⁴ Julian	Maturity Date⁵ Julian
Mountrail	139.2*	62.9	13.4	98.4*	40.1	184.7	227.3
Grenora	134.5	63.1	13.9	96.7*	37.8	185.0	228.4
Divide	139.6*	63.3	13.8	99.3*	40.6	185.6	227.4
Tioga	138.7*	63.6*	14.0	93.6	43.2	185.9	228.6
Carpio	143.5*	63.5*	13.6	98.0*	42.0	187.0	229.1
Joppa	143.0*	63.6*	13.3	99.3*	40.9	185.0	227.6
ND-Riveland	136.1	62.8	14.1	98.5*	43.0	185.1	230.1
ND-Grano	150.2**	64.0**	13.9	97.4*	40.6	186.0	230.4
Alzada	122.4	62.6	13.6	95.1	28.6	182.0	225.3
CDC-Vivid	138.3*	62.9	14.5*	97.6*	40.8	186.0	228.8
MTD16001	133.7	61.8	13.1	98.2*	38.4	185.0	227.6
MTD16002	145.2*	62.3	13.8	98.1*	43.3	186.0	228.4
Lustre	141.5*	61.9	13.8	95.8	40.3	185.6	226.6
MTD18213	146.8*	62.0	14.2	97.6*	44.3	186.9	230.2
MTD18486	147.3*	62.7	13.6	95.1	44.9*	187.6*	232.9*
MTD18413	138.9*	63.0	14.6*	98.1*	42.6	185.3	228.5
MTD18348	140.6*	63.3	14.0	99.5**	44.3	187.0	231.0
MTD18091	141.8*	63.2	13.8	94.9	40.9	186.7	230.8
MTD18430	136.7	61.4	13.8	83.5	46.3*	187.6*	231.2
MTD18179	119.2	60.7	14.3	97.4*	38.1	185.1	229.1
MTD18172	146.3*	63.6*	14.4	93.3	40.5	187.0	230.2
MTD18067	146.4*	62.8	13.6	92.1	40.5	185.4	230.6
MTD18381	121.6	62.3	14.7*	97.5*	37.8	184.0	226.5
MTD18181	125.6	62.3	14.7*	93.8	41.4	187.7*	230.1
MTD18256	142.8*	62.6	14.5	95.1	44.9*	187.3	231.1
MTD18217	148.9*	61.9	14.0	96.3	45.9*	187.6*	232.0*
MTD18266	149.5*	62.1	14.9**	94.0	45.9*	187.3	231.6
MTD18148	132.9	62.4	13.5	93.9	28.8	183.6	227.3
MTD18313	128.1	63.2	13.9	98.4*	29.6	182.3	227.8
MTD18155	137.5	62.4	14.1	98.1*	37.0	185.3	229.2
Average	135.9	62.8	13.8	96.3	38.2	185.5	228.9
LSD (p=0.05)	12.2	0.7	0.4	2.2	1.5	1.0	1.7
Prob > F	<0.001	<0.001	<0.001	0.020	<0.001	<0.001	<0.001
CV%	4.9	0.6	1.8	6.1	2.2	0.3	0.4
Lattice RE% ⁶	256	285	154	116	140	102	674

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Percent stand visually estimated at Feeke's growth stage 2 and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴>50% of heads visible.

⁵>50% of heads senesced.

⁶Adjusted means provided for Lattice RE% values equal to or greater than 100%. Some lines used in analysis are excluded from data table.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 5. Agronomic Data Bozeman Dryland 2020 Durum Variety Trial.

Cultivar	Yield ¹ bu/ac	Test Weight lb/bu	Protein ² %	Stand ³ %	Plant Height Inches	Heading Date ⁴ Julian	Maturity Date ⁵ Julian
Mountrail	109.8	61.2*	14.2	97.6	38.9	184.0	217.3
Grenora	107.6	61.1*	14.3	94.6	35.6	184.3	219.0
Divide	97.1	61.5*	14.5	95.1	38.5	184.3	218.9
Tioga	104.3	61.5*	14.8	93.6	41.2	184.3	219.8
Carpio	109.7	61.3*	14.1	94.8	39.8	184.9	220.9
Joppa	106.4	61.8*	14.0	95.4	38.6	184.5	220.2
ND-Riveland	108.6	60.9	14.9	95.2	39.0	184.6	222.0
ND-Grano	117.4*	61.9**	14.2	98.0	39.5	185.5	221.6
Alzada	98.4	61.0*	14.1	100.0*	28.7	180.8	216.7
CDC-Vivid	108.6	61.0*	15.5*	95.1	38.8	185.0	220.3
MTD16001	95.6	60.5	13.6	94.8	37.8	184.4	219.6
MTD16002	116.4*	60.5	14.6	99.3*	41.4	185.2	219.6
Lustre	114.1*	60.2	14.5	99.4*	38.8	184.7	218.3
MTD18213	107.6	59.5	15.0	93.2	41.4	185.6	221.4
MTD18486	121.6**	61.2*	14.8	95.3	44.0*	187.1*	223.4*
MTD18413	113.9*	61.2*	15.2*	93.7	41.1	184.6	220.0
MTD18348	112.2*	61.2*	15.1	100.0*	38.7	184.8	221.4
MTD18091	107.6	61.4*	14.2	94.8	39.6	185.0	221.8
MTD18430	105.6	59.1	14.9	81.9	45.1*	187.7*	223.5*
MTD18179	99.3	59.3	15.0	99.4*	37.0	183.3	217.7
MTD18172	108.5	61.4*	15.1	95.8	38.7	185.8	220.7
MTD18067	110.6*	60.9	14.3	95.4	38.2	184.3	220.5
MTD18381	96.9	60.6	14.9	95.2	36.3	182.5	217.6
MTD18181	95.7	59.6	15.6*	92.4	40.7	187.5*	222.1
MTD18256	116.8*	61.2*	15.2*	98.2	43.3*	186.8	222.4
MTD18217	108.9	60.2	14.7	94.1	44.2*	187.3*	223.5*
MTD18266	110.5*	61.5*	15.2*	94.3	42.5*	186.7	222.5*
MTD18148	108.0	60.8	14.2	98.3	28.2	183.6	218.5
MTD18313	102.5	61.5*	14.6	98.3*	29.5	181.6	216.9
MTD18155	107.5	60.6	15.1	97.3	36.6	184.5	218.9
Average	106.4	60.9	14.5	96.3	36.9	184.6	220.0
LSD (p=0.05)	11.4	0.9	0.4	1.7	2.7	1.0	2.5
Prob > F	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CV%	5.9	0.8	1.7	5.6	4.1	0.3	0.6
Lattice RE% ⁶	159	168	188	105	115	144	122

¹Grain yield reported on a 13% moisture basis.²Grain protein reported on a 12% moisture basis.³Percent stand visually estimated at Feeke's growth stage 2 and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.⁴>50% of heads visible.⁵>50% of heads senesced.⁶Adjusted means provided for Lattice RE% values equal to or greater than 100%. Some lines used in analysis are excluded from data table.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 6. Agronomic Data SARC Dryland 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Stand³ %	Plant Height Inches	Leaf Spot⁴ 0-9	Heading Date⁵ Julian
Mountrail	74.8*	61.8	15.0	100.0**	36.5	3.4	171.2
Grenora	70.8*	61.6	14.9	95.5	34.5	3.2	170.0
Divide	74.5*	61.8	16.0	100.0*	38.4	3.9	169.6
Tioga	79.3*	62.0	16.1	100.0*	40.7*	3.8	169.7
Carpio	74.3*	60.7	15.9	98.9*	38.6	2.7	171.6
Joppa	78.4*	62.4	15.0	100.0*	39.3*	3.6	170.1
ND-Riveland	71.6*	60.9	15.9	100.0*	39.7*	3.0	171.3
ND-Grano	77.2*	62.1	15.3	98.9*	36.8	3.3	171.4
Alzada	63.4	62.4	15.5	93.3	30.7	5.4**	163.4
MTD18155	66.0	61.8	16.1	98.9*	31.9	4.3	170.0
CDC-Vivid	68.2	62.1	16.4	100.0*	36.7	2.7	171.2
MTD16001	64.3	60.4	15.5	100.0*	35.2	3.6	169.0
MTD16002	73.6*	61.2	15.6	100.0*	40.3	3.8	170.3
Lustre	78.4*	60.8	16.3	100.0*	38.5	4.0	170.2
MTD18213	70.8*	60.0	16.1	98.9*	38.2	2.9	172.3
MTD18486	66.3	60.6	15.5	98.9*	38.9	2.6	174.4**
MTD18413	71.3*	60.7	17.1**	100.0*	36.8	3.6	169.4
MTD18348	76.1*	61.5	16.1	100.0*	40.7*	3.3	171.7
MTD18091	72.9*	61.1	15.2	98.9*	38.0	3.6	171.7
MTD18430	68.3	59.1	15.8	87.0	41.7**	3.3	173.7*
MTD18179	77.0*	60.1	16.4	100.0*	37.1	4.4	169.0
MTD18172	77.6*	62.3	16.5	100.0*	38.5	4.5	171.7
MTD18067	74.2*	60.8	15.4	98.9*	36.8	3.4	170.0
MTD18381	67.3	62.0	16.2	98.9*	36.9	5.1	165.4
MTD18181	69.8*	60.9	16.5	100.0*	39.0	3.3	172.7*
MTD18256	64.6	60.8	16.9*	98.9*	39.9*	2.9	172.3
MTD18217	69.6*	60.7	15.5	98.9*	39.9*	2.5	173.3*
MTD18266	77.0*	62.0	16.7*	100.0*	39.3*	2.4	171.7
MTD18148	75.3*	62.3	15.2	94.9	29.0	4.4	168.9
MTD18313	80.2**	63.4**	15.6	100.0*	30.0	5.4*	164.3
Average	72.4	61.3	15.9	99.5	37.3	3.6	170.4
LSD (p=0.05)	11.8	0.8	0.6	3.8	2.7	0.3	1.9
Prob > F	0.132	<0.001	<0.001	0.023	<0.001	0.002	<0.001
CV%	9.3	0.8	2.2	7.9	4.3	10.9	0.7
Lattice RE% ⁶	111	104	102	100	100	128	101

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Percent stand visually estimated at Feeke's growth stage 10.54 and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴Fungal leaf spotting estimated on a score from 0 to 9 (0=none to 9=complete) post-anthesis. Transformed by natural logarithm for analysis with displayed means and LSD converted back to scores.

⁵>50% of heads visible

⁶Adjusted means provided for Lattice RE% values greater than 100%.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 7. Agronomic Data CARC Dryland 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height Inches	Heading Date³ Julian
Mountrail	37.2	62.9	11.6	30.1	183.7
Grenora	37.3	63.3	11.9	28.1	182.1
Divide	38.4	62.9	11.6	30.9	183.1
Tioga	36.0	63.0	12.0	33.4*	184.1
Carpio	37.2	61.9	12.0	30.8	185.2
Joppa	38.9	62.9	11.4	30.7	183.1
ND-Riveland	35.3	62.4	12.0	31.8	185.0
ND-Grano	34.2	63.7	11.6	30.7	185.6
Alzada	34.5	63.1	11.9	25.8	182.0
MTD18155	35.3	63.2	11.9	26.9	183.1
CDC-Vivid	38.9	63.4	12.5*	30.2	182.9
MTD16001	37.7	61.4	11.7	29.9	184.1
MTD16002	39.8	62.6	11.1	34.1*	185.3
Lustre	41.6**	61.9	11.6	32.2	184.4
MTD18213	39.9	61.4	12.2*	30.6	185.5
MTD18486	37.2	62.6	12.0	30.6	186.8*
MTD18413	34.2	63.4	12.1*	28.8	182.1
MTD18348	36.0	63.3	11.6	30.2	184.7
MTD18091	36.9	62.7	11.7	30.7	185.1
MTD18430	31.8	60.7	11.9	35.4**	188.0**
MTD18179	40.3	60.9	11.9	29.6	182.6
MTD18172	37.6	63.6	12.1*	29.2	186.1
MTD18067	34.9	62.4	11.5	29.0	184.1
MTD18381	35.6	62.5	12.6*	29.3	182.4
MTD18181	34.5	62.9	12.4*	31.2	187.1*
MTD18256	39.5	63.1	11.6	30.9	185.3
MTD18217	35.7	62.3	11.3	31.6	187.6*
MTD18266	37.3	63.9	12.1*	31.0	185.1
MTD18148	36.6	63.4	12.3*	22.1	183.4
MTD18313	36.0	65.0**	12.5**	23.0	181.0
Average	36.9	62.8	11.9	30.0	184.4
LSD (p=0.05)	4.8	0.4	0.5	2.4	1.2
Prob > F	0.065	<0.001	<0.001	<0.001	<0.001
CV%	7.6	0.4	2.5	4.7	0.4
Lattice RE% ⁴	104	163	164	108	117

¹Grain yield reported on a 13% moisture basis.²Grain protein reported on a 12% moisture basis.³>50% of heads visible⁴Adjusted means provided for Lattice RE% values equal to or greater than 100%.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 8. Agronomic Data 2nd Nature Research Dryland Conrad, MT 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height Inches
Mountrail	50.4	55.3	16.4	37.7
Grenora	47.4	56.0	15.8	36.8
Divide	49.5	56.8	14.8	37.4
Tioga	46.6	56.8	16.0	40.8*
Carpio	43.4	54.0	16.0	35.8
Joppa	41.5	56.5	16.5	38.6
ND-Riveland	49.6	56.4	16.7	38.3
ND-Grano	41.6	56.3	16.8	36.7
Alzada	57.5*	56.1	15.3	33.4
MTD18155	56.5*	55.6	16.2	35.8
CDC-Vivid	47.8	56.5	15.7	37.3
MTD16001	51.4	55.9	15.8	37.9
MTD16002	50.5	55.1	16.1	40.6*
Lustre	44.4	54.3	15.9	38.8
MTD18213	41.1	52.8	17.3**	40.3*
MTD18486	50.8	54.8	16.6	39.2*
MTD18413	49.4	57.2	14.9	36.0
MTD18348	51.9	55.7	16.0	41.6*
MTD18091	47.5	54.9	16.3	38.8
MTD18430	49.5	55.1	15.8	42.3**
MTD18179	54.3*	55.1	16.4	36.1
MTD18172	48.3	57.1*	16.2	38.9
MTD18067	43.1	54.8	16.4	39.6*
MTD18381	46.9	56.2	15.5	36.9
MTD18181	44.3	55.1	16.9	39.8*
MTD18256	46.1	55.1	16.4	39.4*
MTD18217	46.2	56.1	15.2	40.7*
MTD18266	49.0	57.4*	15.5	36.8
MTD18148	53.7	55.0	15.5	27.7
MTD18313	62.1*	59.0*	14.5	29.7
Average	48.7	55.8	16.0	37.7
LSD (p=0.05)	8.1	2.0	1.4	3.2
Prob > F	<0.001	<0.001	0.079	<0.001
CV%	9.1	2.0	4.8	4.7
Lattice RE% ³	145	152	290	134

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Adjusted means provided for Lattice RE% values equal to or greater than 100%.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 9. Agronomic Data NARC Dryland 2020 Durum Variety Trial.

Cultivar	Yield ¹ bu/ac	Test Weight lb/bu	Protein ² %	Plant Height Inches	Sawfly ³ %	Heading Date ⁴ Julian	Falling number ⁵ sec
Mountrail	56.4*	59.6	14.9	31.9	7.5*	178.0	474.1
Grenora	51.1	59.1	15.3	30.9	3.5	177.7	494.6
Divide	55.2*	60.2	15.0	33.6*	0.5	178.0	447.5
Tioga	52.9	59.6	15.3	31.8	0.5	179.7	460.2
Carpio	48.7	58.3	15.5	31.2	0.5	181.3	432.6
Joppa	54.2	60.0	14.3	34.1*	3.5	180.0	442.9
ND-Riveland	53.4	59.2	15.0	32.0	5.0*	178.7	451.8
ND-Grano	50.9	60.0	15.2	30.9	2.8	180.6	443.3
Alzada	57.3*	59.5	15.0	28.3	8.4**	174.7	514.5*
MTD18155	58.6*	59.4	14.9	29.7	0.1	179.0	413.2
CDC-Vivid	54.6	59.3	16.2	33.3	2.1	179.3	452.7
MTD16001	57.1*	59.4	14.5	32.3	0.5	178.0	445.2
MTD16002	60.5*	59.5	14.7	33.1	1.0	179.7	502.2
Lustre	54.4	58.9	15.1	32.8	1.3	180.0	443.3
MTD18213	49.1	56.4	16.0*	34.0*	0.5	181.3	464.0
MTD18486	50.4	58.7	15.4	34.1*	0.1	183.0*	471.8
MTD18413	53.4	58.8	15.4	33.0	1.0	178.0	422.3
MTD18348	55.4*	58.6	15.2	34.0*	0.5	181.0	528.4**
MTD18091	48.5	58.3	15.8*	31.8	2.1	181.0	439.9
MTD18430	48.9	55.8	16.0*	36.2**	1.0	183.3**	516.7*
MTD18179	48.6	56.3	16.7*	29.3	2.1	178.0	432.0
MTD18172	57.1*	60.7	15.2	31.0	6.1*	179.0	437.3
MTD18067	57.5*	58.6	14.3	34.3*	6.1*	180.0	398.8
MTD18381	47.2	58.8	15.7	30.6	4.6*	177.3	444.1
MTD18181	49.0	58.5	16.2*	35.5*	2.1	181.7*	420.3
MTD18256	51.1	59.1	16.8*	32.4	0.5	181.7*	489.6
MTD18217	45.8	58.0	16.3*	31.3	0.5	182.3*	451.6
MTD18266	49.1	59.2	16.9**	32.6	0.5	181.7*	464.3
MTD18148	53.5	59.2	14.9	23.6	1.0	178.0	505.2
MTD18313	61.0**	61.9**	14.4	25.9	0.1	174.7	452.7
Average	53.0	59.0	15.4	31.9	1.8	179.6	458.6
LSD (p=0.05)	6.4	0.9	1.1	2.6	1.7	1.8	21.7
Prob > F	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CV%	7.4	0.9	4.4	5.0	18.0	0.6	2.7
Lattice RE% ⁶	100	108	100	100	100	100	108

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Lodging due to sawfly cutting. Percentages were transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴>50% of heads visible

⁵Falling number reported on a 14% moisture basis

⁶Adjusted means provided for Lattice RE% values equal to or greater than 100%.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 10. Agronomic Data EARC Dryland 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height Inches	Stand³ %	Heading Date⁴ Julian
Mountrail	53.0	62.7	15.3	26.9	73.8	175.0
Grenora	45.7	63.4	15.2	25.3	87.0	173.7
Divide	44.3	63.5	15.7	27.8*	81.9	174.3
Tioga	42.0	63.6	15.4	29.4*	83.8	175.7
Carpio	48.8	63.5	15.3	26.5	88.4	176.3
Joppa	44.5	63.6	15.3	27.0	73.8	174.0
ND-Riveland	48.4	63.6	15.9	29.4*	77.0	175.3
ND-Grano	42.2	63.9	15.6	26.1	85.2	176.0
Alzada	39.0	62.3	14.1	22.4	83.4	169.7
MTD18155	44.5	62.9	15.8	25.3	87.8	173.3
CDC-Vivid	48.8	62.8	16.1	28.0*	88.4	174.0
MTD16001	43.3	62.7	14.9	27.0	81.7	175.7
MTD16002	45.0	63.4	16.0	28.0*	81.0	176.7
Lustre	48.5	62.2	16.0	27.7*	83.4	175.3
MTD18213	45.7	62.0	15.8	26.8	85.2	176.7
MTD18486	44.8	64.1*	15.7	26.1	90.0**	178.7*
MTD18413	43.4	63.1	16.3	26.4	83.4	172.7
MTD18348	55.4**	62.9	15.3	29.1*	86.8	177.0
MTD18091	43.1	63.4	15.3	26.5	83.6	176.0
MTD18430	44.8	61.7	15.8	29.1*	83.4	179.3*
MTD18179	40.0	61.2	16.3	27.3*	78.6	174.3
MTD18172	45.1	64.0*	16.6*	26.8	88.4	175.3
MTD18067	48.0	62.7	15.6	26.9	77.2	175.3
MTD18381	38.2	61.9	15.3	24.8	80.5	173.3
MTD18181	38.9	63.6	16.4*	28.5*	75.1	178.3*
MTD18256	51.3	63.0	16.0	29.3*	86.8	177.7
MTD18217	45.1	63.1	16.2	27.0	80.2	179.3**
MTD18266	47.3	63.7	16.8**	27.0	83.4	177.3
MTD18148	43.6	63.1	14.8	20.2	83.6	172.3
MTD18313	42.1	64.5**	15.4	21.5	77.0	169.3
Average	45.2	63.1	15.7	26.7	82.9	175.3
LSD (p=0.05)	11.0	0.6	0.5	2.2	2.1	1.5
Prob > F	0.304	<0.001	<0.001	<0.001	0.189	<0.001
CV%	15.1	0.5	1.9	5.1	7.9	0.5

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Percent stand visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴>50% of heads visible

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 11. Agronomic Data EARC Irrigated 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Moisture %	Protein² %	Plant Height Inches	Heading Date³ Julian
Mountrail	105.3**	64.0*	10.1	13.9	39.1	178.0
Grenora	88.1	63.4	10.0	14.4	36.0	176.7
Divide	95.7*	64.1*	10.2	14.6	39.0	178.7
Tioga	93.7*	63.6*	10.3	14.2	39.9	177.7
Carpio	102.5*	63.8*	10.2	14.3	38.3	178.0
Joppa	93.8*	64.0*	10.4	14.1	38.3	177.7
ND-Riveland	97.4*	64.1*	10.2	14.0	41.4*	178.0
ND-Grano	102.8*	64.0*	10.1	14.0	36.7	178.3
Alzada	77.6	61.6	9.9	14.6	29.9	173.3
MTD18155	86.3	62.3	9.9	15.0*	31.4	177.0
CDC-Vivid	83.9	63.3	10.1	15.5**	35.6	178.3
MTD16001	99.6*	63.2	10.0	13.7	35.7	178.0
MTD16002	90.7*	63.5	10.0	14.7	38.0	179.3
Lustre	93.6*	63.2	10.1	15.0*	38.2	178.3
MTD18213	102.7*	63.7*	10.2	13.9	40.7*	178.7
MTD18486	98.2*	64.2*	10.6	13.3	38.6	182.0*
MTD18413	93.7*	62.9	10.1	15.3*	37.0	178.0
MTD18348	91.3*	64.0*	10.3	14.1	41.4*	180.3
MTD18091	94.5*	64.5**	10.2	13.5	38.4	178.3
MTD18430	83.2	62.5	10.6	14.6	43.1**	182.0**
MTD18179	105.1*	63.0	10.2	14.4	38.2	177.3
MTD18172	93.6*	64.0*	10.3	14.9	37.3	180.3
MTD18067	97.8*	62.3	10.4	14.2	37.7	178.0
MTD18381	82.8	62.5	10.1	15.3*	35.7	175.3
MTD18181	77.7	62.9	10.5	15.3*	39.0	181.7*
MTD18256	90.9*	63.5	10.2	14.2	41.3*	180.3
MTD18217	96.8*	63.9*	10.4	14.1	41.5*	180.7
MTD18266	94.2*	64.3*	10.2	14.7	37.0	180.7
MTD18148	90.4	62.5	10.0	14.7	28.5	175.0
MTD18313	94.9*	63.9*	10.0	14.7	29.3	174.7
Average	93.3	63.4	10.2	14.4	37.4	178.4
LSD (p=0.05)	14.9	1.0	0.2	0.6	3.2	1.2
Prob > F	0.016	<.0001	<.0001	<.0001	<.0001	<.0001
CV%	8.6	0.9	1.3	2.4	4.9	0.4
Lattice RE% ⁴	103	115	100	101	104	100

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³>50% of heads visible

⁴Adjusted means provided for Lattice RE% values equal to or greater than 100%.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 12. Agronomic Data Turner Dryland Off-station 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height Inches	Stand³ %	Sawfly⁴ %	Falling number⁵ sec
Mountrail	43.9*	58.1	15.1	28.6	99.5	0.4	451.0
Grenora	44.8*	58.6*	15.2	28.5	99.6	0.4	492.7
Divide	40.4	58.6*	15.6	29.7*	100.0	0.4	453.3
Tioga	40.8	58.2*	15.5	31.0*	100.0	0.1	461.5
Carpio	44.1*	57.7	15.3	27.5	99.8	0.4	462.0
Joppa	44.2*	58.7**	15.2	29.4	100.0	0.1	455.6
ND-Riveland	45.3*	58.1	16.0	30.2**	99.9	0.4	499.6
ND-Grano	44.4*	58.7*	15.6	25.9	100.0	1.0	483.9
Alzada	45.6**	57.5	15.1	25.0	99.7	0.1	552.3**
CDC-Vivid	38.7	57.8	16.7*	26.5	98.9	0.4	447.7
CDC-Dynamic	40.6	57.7	16.8**	28.9	100.0	0.0	393.3
CDC-Fortitude	44.6*	58.1	16.5*	26.8	100.0	0.0	468.8
MTD-16001	42.6	57.3	15.4	29.1	99.8	0.0	427.3
MTD16002	45.4*	58.7*	15.4	30.1*	100.0	0.0	477.0
Lustre	43.0*	57.0	16.4	28.7	99.4	1.0	436.4
Average	43.2	58.1	15.7	28.4	99.9	0.2	464.2
LSD (p=0.05)	2.9	0.6	0.4	1.6	0.8	0.1	21.7
Prob > F	<0.001	<0.001	<0.001	<0.001	0.284	0.079	<0.001
CV%	4.1	0.6	1.6	3.4	3.5	100.1	2.8

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Percent stand visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴ Lodging due to sawfly cutting visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent cutting.

⁵ Falling number reported on a 14% moisture basis

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 13. Agronomic Data Chester Dryland Off-station 2020 State Durum Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height Inches	Stand³ %	Sawfly⁴ %	Falling number⁵ sec
Mountrail	51.2*	55.3	18.0	38.7	99.8	0.4	456.9
Grenora	50.7*	56.7	17.1	35.7	98.7	1.2	510.3*
Divide	45.4	56.4	17.3	38.6	99.4	0.4	438.0
Tioga	46.3	56.4	18.3	38.4	98.9	1.0	494.1
Carpio	42.5	53.9	17.9	37.5	99.9	0.1	399.5
Joppa	48.5*	56.7	17.1	39.2	99.9	1.0	430.1
ND-Riveland	47.0	56.1	17.8	38.1	98.4	1.0	459.0
ND-Grano	45.6	55.7	18.9	36.4	99.9	1.0	419.1
Alzada	52.3**	55.8	16.9	31.1	98.7	1.0	526.6**
CDC-Vivid	44.1	55.3	19.2	37.2	100.0	0.1	401.8
CDC-Dynamic	46.7	54.7	19.5	37.4	99.6	0.4	361.1
CDC-Fortitude	47.8	55.3	18.9	36.0	99.8	0.0	440.1
MTD-16001	47.9*	54.9	17.4	38.1	99.9	0.0	444.0
MTD16002	44.1	54.3	17.3	39.3	98.9	0.4	453.4
Lustre	47.5	54.6	18.0	38.6	99.7	0.4	428.7
Average	47.2	55.5	18.0	37.3	99.6	0.5	444.2
LSD (p=0.05)	4.4	0.8	0.7	1.7	1.9	0.7	29.9
Prob > F	0.005	<0.001	<0.001	<0.001	0.787	0.120	<0.001
CV%	5.6	0.9	2.4	2.7	5.5	68.8	4.0

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Percent stand visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴ Lodging due to sawfly cutting visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent cutting.

⁵ Falling number reported on a 14% moisture basis

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 14. Agronomic Data Loring Dryland Off-station 2020 State Durum Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height Inches	Stand³ %	Sawfly⁴ %	Falling number⁵ sec
Mountrail	46.3	60.4	15.1	26.0	98.7	1.0	418.0
Grenora	43.2	60.5	15.0	26.0	97.5	0.4	416.6
Divide	41.0	60.0	15.4	29.0*	96.8	0.1	386.2
Tioga	46.7	61.1*	14.7	30.2**	99.0	0.4	397.9
Carpio	48.3	60.4	14.4	24.6	97.8	0.4	415.3
Joppa	46.8	61.2**	14.2	29.5*	99.6	0.4	423.1
ND-Riveland	52.3*	60.5	14.3	29.0*	98.7	0.4	447.6
ND-Grano	52.5**	61.2*	14.6	26.2	99.4	0.1	458.1
Alzada	38.8	60.3	15.2	22.6	97.3	0.4	519.5**
CDC-Vivid	45.8	60.0	15.2	28.8*	99.0	0.1	445.8
CDC-Dynamic	44.3	59.4	16.1**	27.1	98.9	0.1	407.2
CDC-Fortitude	41.6	59.6	15.9*	23.9	97.0	0.0	446.1
MTD16001	48.8*	59.8	14.0	28.6*	99.6	0.1	421.7
MTD16002	52.0*	60.7	14.1	27.0	99.7	0.4	478.3
Lustre	42.6	59.2	15.3	27.7	95.7	0.1	455.0
Average	46.1	60.3	14.9	27.1	98.5	0.3	435.7
LSD (p=0.05)	3.9	0.4	0.5	1.7	1.1	0.6	25.7
Prob > F	<0.001	<0.001	<0.001	<0.001	0.127	0.651	<0.001
CV%	5.0	0.4	1.8	3.8	4.4	87.1	3.5

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Percent stand visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴ Lodging due to sawfly cutting visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent cutting.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 15. Agronomic Data EARC Poplar Dryland Off-station 2020 Durum Variety Trial.

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height inch
Mountrail	68.8**	63.7*	15.1	32.5
Divide	60.7	63.6*	15.7	35.8*
Grenora	61.7*	63.6*	14.9	33.5
Carpio	64.1*	63.9*	14.7	35.0
Joppa	59.7	64.0*	14.5	36.4*
ND-Grano	62.0*	64.1**	15.2	34.1
ND-Riveland	64.8*	63.5	14.8	36.1*
Tioga	68.1*	64.1*	15.3	36.6*
Alzada	48.0	62.1	14.2	27.3
CDC-Dynamic	63.3*	63.5	15.9	34.5
CDC-Fortitude	55.4	63.0	16.1*	31.2
CDC-Vivid	60.8	63.4	16.3*	34.3
MTD-16001	59.1	62.6	14.6	32.9
MTD16002	65.4*	63.4	15.0	37.5**
Lustre	63.4*	62.8	15.7	33.7
Transcend	55.5	63.7*	16.4**	36.9*
Average	61.3	63.4	15.3	34.3
LSD (p=0.05)	7.4	0.6	0.4	2.1
Prob > F	<0.001	<0.001	<0.001	<0.001
CV%	7.2	0.5	1.4	3.7

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 16. Agronomic Data EARC Dagmar Dryland Off-station 2020 Durum Variety Trial.

Cultivar	Yield bu/ac	Test Weight lb/bu	Protein %	Plant Height inch
Mountrail	60.3*	64.4	14.1	30.8*
Divide	58.7*	64.9*	14.6	31.4*
Grenora	56.5	64.6*	13.8	27.7
Carpio	64.4*	64.9*	13.7	31.8*
Joppa	54.1	65.1*	13.6	31.8*
ND-Grano	55.9	64.9*	13.8	31.5*
ND-Riveland	56.6	64.2	14.2	32.4*
Tioga	56.5	64.6*	14.1	33.3*
Alzada	47.6	63.4	13.5	25.6
CDC-Dynamic	62.6*	64.6*	15.2*	31.2*
CDC-Fortitude	57.4	64.4	14.7	29.0
CDC-Vivid	59.1*	64.4	15.1*	32.0*
MTD-16001	59.9*	64.0	13.5	32.0*
MTD16002	61.2*	64.4	14.1	33.5**
Lustre	58.6*	64.3	14.9*	31.0*
Transcend	63.3**	65.1**	15.3**	32.3*
Average	58.3	64.5	14.3	31.1
LSD (p=0.05)	6.1	0.5	0.4	2.8
Prob > F	0.001	<0.001	<0.001	<0.001
CV%	6.3	0.5	1.8	5.4

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 17. Agronomic Data All EARC Dryland Off-station 2020 Durum Variety Trials (n=2).

Cultivar	Yield bu/ac	Test Weight lb/bu	Protein %	Plant Height inch
Mountrail	64.6**	64.1	14.6	31.7
Divide	59.7*	64.3*	15.2	33.6**
Grenora	59.1*	64.1	14.4	30.6
Carpio	64.3*	64.4*	14.2	33.4
Joppa	56.9	64.6*	14.1	34.1*
ND-Grano	59.0*	64.5*	14.5	32.8
ND-Riveland	60.7*	63.9	14.5	34.3*
Tioga	62.3*	64.4*	14.7	35.0*
Alzada	47.8	62.8	13.9	26.5
CDC-Dynamic	63.0*	64.1	15.6*	32.9
CDC-Fortitude	56.4	63.7	15.4	30.1
CDC-Vivid	64.6**	64.1	14.1	33.2
MTD-16001	59.5*	63.3	14.1	32.5
MTD16002	63.3*	63.9	14.6	35.5**
Lustre	61.0*	63.6	15.3	32.4
Transcend	59.4*	64.4*	15.9**	34.6*
Average	59.8	64.0	14.8	32.7
LSD (p=0.05)	7.2	0.4	0.4	2.0
Prob > F	0.027	<0.001	<0.001	<0.001
CV%	5.6	0.3	1.1	2.8

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 18. Agronomic Data All NARC Dryland Off-station 2020 State Durum Trials (n=3).

Cultivar	Yield¹ bu/ac	Test Weight lb/bu	Protein² %	Plant Height Inches	Stand³ %	Sawfly⁴ %	Falling number⁵ sec
Mountrail	47.1	57.9	16.1	31.1	99.4	0.6*	442.0
Grenora	46.2	58.6*	15.8	30.1	98.7	0.6*	473.2
Divide	42.3	58.3*	16.1	32.4*	99.3	0.3	425.8
Tioga	44.6	58.6*	16.2	33.2**	99.5	0.4	451.2
Carpio	45.0	57.3	15.9	29.9	99.4	0.3	425.6
Joppa	46.5	58.9**	15.5	32.7*	99.9	0.4	436.3
ND-Riveland	48.2**	58.2*	16.0	32.4*	99.2	0.6*	468.7
ND-Grano	47.5	58.5*	16.4	29.5	99.9	0.6*	453.7
Alzada	45.6	57.9	15.7	26.2	98.8	0.4	532.8**
CDC-Vivid	42.9	57.7	17.0*	30.8	99.5	0.2	431.8
CDC-Dynamic	43.9	57.3	17.5**	31.1	99.7	0.1	387.2
CDC-Fortitude	44.7	57.7	17.1*	28.9	99.5	0.0	451.7
MTD16001	46.4	57.3	15.6	31.9*	99.8	0.0	431.0
MTD16002	47.2	57.9	15.6	32.1*	99.7	0.2	469.6
Lustre	44.4	56.9	16.6	31.7*	98.7	0.4	440.0
Average	45.5	57.9	16.2	30.9	99.5	0.3	448.0
LSD (p=0.05)	5.4	0.8	0.7	1.7	0.4	0.02	41.9
Prob > F	0.600	<0.001	<0.001	<0.001	0.244	0.018	<0.001
CV%	7.1	0.8	2.7	3.4	2.6	48.0	5.6

¹Grain yield reported on a 13% moisture basis.

²Grain protein reported on a 12% moisture basis.

³Percent stand visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent stand.

⁴ Lodging due to sawfly cutting visually estimated and transformed by arcsin of the square root prior to analysis. Displayed means and LSD are converted back to percent cutting.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 19: Responses to Fusarium Head Blight 2020 Durum Variety Trial.

Cultivar	Severity^a %	Incidence^b %	Index^c	FDK^d %	Yield Bu/ac	DON^e PPM
Alzada	29.4 A	90.0 A	26.6 A	20.0 A-D	27.6	6.4
Carpio	9.8 G-J	63.3 B-E	6.3 I-L	26.7 A-D	6.3	8.1
Divide	13.7 D-J	70.0 A-E	9.8 D-L	23.3 A-D	5.8	6.6
CDC-Dynamic	19.1 B-G	82.2 A-C	15.7 B-I	28.3 A-D	16.2	6.9
ND-Grano	14.3 D-J	80.0 A-C	11.5 D-L	20.0 A-D	30.0	7.0
Grenora	14.6 D-J	80.0 A-C	11.7 D-L	18.3 B-D	34.5	5.2
Joppa	16.1 C-I	78.9 A-D	13.4 C-K	21.7 A-D	26.0	6.1
Mountrail	22.2 A-D	77.8 A-D	17.3 A-G	16.7 CD	19.6	3.6
ND- Riveland	10.0 G-J	70.0 A-E	7.0 I-L	18.3 B-D	7.5	7.4
Silver	28.2 AB	87.8 A	24.8 AB	41.7 AB	24.3	-
Tioga	11.5 F-J	71.1 A-E	8.4 F-L	28.3 A-D	25.8	4.7
CDC-Vivid	21.1 A-E	81.1 A-C	17.2 A-H	15.0 D	18.1	6.0
MTD16001	14.7 D-J	74.4 A-D	10.9 D-L	16.7 CD	15.9	4.0
MTD16002	10.8 G-J	68.9 A-E	7.5 H-L	23.3 A-D	14.9	6.7
Lustre	19.2 B-G	77.8 A-D	15.0 C-J	25.0 A-D	24.5	7.1
MTD18067	13.1 D-J	74.4 A-D	9.7 D-L	43.3 A	15.8	12.3
MTD18091	8.4 H-J	67.8 A-E	5.8 J-L	25.0 A-D	11.0	8.2
MTD18148	20.9 A-F	86.7 AB	18.3 A-E	30.0 A-D	36.5	7.2
MTD18155	21.4 A-E	87.8 A	18.8 A-D	16.7 CD	26.9	2.7
MTD18172	12.4 E-J	70.0 A-E	8.7 E-L	43.3 A	7.2	11.9
MTD18179	22.3 A-D	81.1 A-C	18.2 A-F	20.0 A-D	17.7	6.4
MTD18181	17.6 C-H	74.4 A-D	13.1 C-K	30.0 A-D	7.9	7.2
MTD18213	7.5 IJ	55.6 DE	4.2 KL	26.7 A-D	5.1	9.4
MTD18217	8.9 H-J	62.2 C-E	5.7 J-L	43.3 A	2.1	13.0
MTD18256	12.8 D-J	67.8 A-E	8.7 E-L	38.3 A-D	8.2	-
MTD18266	11.4 G-J	71.1 A-E	8.2 G-L	40.0 A-C	8.8	12.7
MTD18348	8.2 H-J	67.8 A-E	5.6 J-L	28.3 A-D	2.6	15.3
MTD18381	25.2 A-C	87.8 A	22.2 A-C	21.7 A-D	24.9	-
MTD18413	13.8 D-J	75.6 A-D	10.5 D-L	20.0 A-D	21.3	4.8
MTD18430	6.6 J	50.0 E	3.2 L	31.7 A-D	8.2	5.6
MTD18486	8.3 H-J	61.1 C-E	5.1 KL	33.3 A-D	12.8	-
Average	15.3	74.0	11.9	26.9	16.6	7.5
CV%	43.2	15.3	55.1	39.0	81.4	54.8
HSD (0.05)	9.5	23.8	9.7	23.3	37.6	6.7

Letters in common did not differ significantly according to a Tukey's HSD test at a significance level of 5%.

^aPest Severity: Average percent area of head covered by disease. Thirty heads were evaluated for each plot.

^bPest Incidence: Percent of thirty plants per plot that had visible FHB symptoms.

^cIndex: Severity X Incidence / 100

^dFusarium diseased kernels.

^eDeoxynivalenol concentration in seeds.

Table 20. Seed Quality Data All On-station 2020 Durum Variety Trials (n=8).

Cultivar	Test weight	Large seeds	Small seeds	Hardness index	Individual seed weight	Individual seed diameter	Grain Protein ¹	Grain ash ²	Falling number ²	Grain Moisture
	lbs/bu	%	%		mg	mm	%	%	sec	%
Mountrail	61.2	49.4	12.0*	70.9	41.4	2.88	14.0	1.54	477.0	8.5
Grenora	61.4	61.5	9.1	72.4	42.7	2.92	14.3	1.57*	489.4	8.5
Divide	61.8	67.0	7.2	70.4	42.9	2.94	14.0	1.48	481.6	8.6
Tioga	61.7	69.6	7.1	67.8	44.7*	3.01	14.6	1.56	434.9	8.7*
Carpio	60.9	62.9	9.7*	70.4	41.4	2.90	14.5	1.53	487.6	8.7*
Joppa	61.7	56.7	11.2*	70.6	42.7	2.90	13.9	1.52	450.5	8.7*
ND-Riveland	61.2	69.2	6.6	68.8	44.5*	2.96	14.3	1.54	515.4	8.6
ND-Grano	61.9	55.1	11.6*	71.7	41.2	2.88	14.4	1.56	465.6	8.5
Alzada	61.0	75.9	5.6	68.1	45.0**	3.08**	14.0	1.55	583.5**	8.7*
MTD18155	61.0	67.7	7.6	73.0	40.9	2.95	14.7*	1.55	445.6	8.5
CDC-Vivid	61.5	68.1	7.2	74.1	41.2	2.89	15.1*	1.53	475.9	8.6
MTD16001	60.4	52.2	12.2*	73.5	40.4	2.85	13.9	1.51	482.1	8.6
MTD16002	60.9	53.0	11.4*	76.8*	38.7	2.84	14.2	1.47	517.5	8.6
Lustre	60.5	50.5	11.2*	71.2	41.6	2.87	14.6	1.48	494.2	8.5
MTD18213	59.6	63.0	10.5*	69.4	42.3	2.85	14.8*	1.59*	540.7	8.6
MTD18486	61.4	72.7*	6.7	73.0	41.7	2.93	14.4	1.56	465.1	8.8*
MTD18413	61.4	71.9*	6.1	70.8	43.0	2.95	14.7*	1.51	452.4	8.6
MTD18348	61.4	76.7**	5.0	70.1	44.4*	3.02*	14.6	1.56	522.5	8.8**
MTD18091	61.2	53.4	12.5**	74.5	39.5	2.85	14.2	1.53	483.1	8.6
MTD18430	59.4	59.9	9.5	73.2	41.0	2.86	14.7*	1.59*	514.6	8.7*
MTD18179	59.2	54.9	11.1*	76.2	38.9	2.83	15.1*	1.53	492.9	8.7*
MTD18172	62.2*	75.6*	5.2	71.3	43.6*	2.99	14.8*	1.51	444.6	8.7*
MTD18067	60.7	60.6	9.1	70.0	44.1*	2.95	14.1	1.57*	433.7	8.7*
MTD18381	60.7	62.9	8.0	73.2	40.6	2.92	14.6	1.56*	492.9	8.6
MTD18181	60.8	62.1	8.4	74.3	41.2	2.92	15.2**	1.54	475.5	8.8*
MTD18256	60.9	63.5	8.4	72.9	42.2	2.94	15.0*	1.61**	490.8	8.7*
MTD18217	60.9	74.5*	6.2	68.4	43.6*	2.96	14.4	1.55	481.3	8.7*
MTD18266	62.1	65.6	7.2	73.9	42.6	2.92	14.9*	1.56	482.9	8.6
MTD18148	61.0	55.0	11.6*	78.3*	39.4	2.87	14.4	1.53	561.0*	8.6
MTD18313	62.8**	66.4	8.9	78.7**	39.7	2.92	14.2	1.53	462.4	8.6
Average	61.1	63.3	8.8	72.3	41.9	2.92	14.5	1.54	486.6	8.6
Prob>F	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
LSD(0.05)	0.6	6.46	2.8	2.2	1.6	0.06	0.6	0.04	26.3	0.1
CV(%)	1.0	10.4	32.1	3.1	3.9	2.0	4.0	3.0	5.5	1.7

¹Reported on a 12% moisture basis

²Reported on a 14% moisture basis

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.

Table 21. Semolina Quality Data All On-station 2020 Durum Variety Trials (n=8).

Cultivar	Bran %	Shorts %	Semolina %	Semolina Protein ¹ %	Semolina Ash ¹ %	L	b*	a*	Peak Mix Time min	Peak Integral %TQ*min	Gluten Index ²
Mountrail	26.1	11.2	62.7**	13.0	0.65	85.4*	26.7	-2.8	2.3	109.4	31.5
Grenora	27.2	12.1	60.7	13.1	0.65	85.2	30.2	-3.1	3.0	145.7	60.0
Divide	26.2	11.5	62.3*	12.8	0.61	85.2	28.9	-3.0	3.3	157.6	73.5
Tioga	25.9	11.5	62.7*	13.3*	0.62	85.0	30.5	-3.1	3.7	177.3	80.5
Carpio	26.6	12.3	61.1	13.2*	0.65	84.9	31.8	-3.4*	4.3	217.0	97.5**
Joppa	26.3	11.5	62.2*	12.7	0.61	85.1	31.2	-3.1	3.9	175.9	87.0
ND-Riveland	28.0*	12.8	59.2	13.1	0.63	85.0	31.4	-3.2	4.0	205.6	89.5*
ND-Grano	26.1	11.4	62.5*	13.1	0.63	85.2	31.6	-3.3*	3.3	160.3	76.5
Alzada	24.6	13.4**	62.0*	12.7	0.67*	84.5	31.9	-3.0	4.1	210.6	94.5*
MTD18155	26.7	11.9	61.5	13.3*	0.63	85.1	28.9	-3.0	3.9	170.4	72.5
CDC-Vivid	26.4	12.6	61.0	13.6*	0.66*	84.5	33.1*	-3.1	4.8**	219.9	86.5
MTD16001	26.3	11.8	61.9*	12.6	0.62	85.1	29.4	-3.0	3.3	159.2	64.5
MTD16002	27.3	11.9	60.9	13.1	0.60	84.9	28.8	-2.9	2.9	137.6	42.5
Lustre	26.4	11.9	61.7	13.4*	0.62	84.9	30.0	-2.9	3.2	152.4	57.0
MTD18213	28.2**	11.8	60.0	13.6*	0.66*	84.6	33.4**	-3.3*	3.4	173.8	77.5
MTD18486	27.6*	12.3	60.1	13.0	0.68*	84.7	32.9*	-3.2	4.8*	242.8**	94.0*
MTD18413	27.7*	11.6	60.8	13.3*	0.61	85.2	28.1	-2.9	3.6	171.6	83.5
MTD18348	26.3	11.7	62.1*	12.9	0.66*	85.0	31.5	-3.3	4.7*	237.8*	96.0*
MTD18091	26.7	11.5	61.9	13.1	0.66*	85.2	31.1	-3.4**	3.5	172.5	85.0
MTD18430	27.5	12.5	60.0	13.6*	0.68**	85.0	30.8	-3.3*	4.0	202.0	87.0
MTD18179	27.8*	12.0	60.2	13.7**	0.63	84.7	32.4	-3.2	4.5	210.1	81.5
MTD18172	26.2	11.9	61.8	13.5*	0.60	85.5*	27.0	-2.9	3.0	132.5	50.0
MTD18067	26.6	11.2	62.2*	12.9	0.64	85.2	29.0	-3.0	3.5	170.3	84.0
MTD18381	25.5	11.9	62.6*	13.3*	0.65	85.1	30.8	-3.2	3.5	160.7	63.5
MTD18181	27.6*	11.3	61.1	13.6*	0.58	85.0	31.9	-3.2	4.1	206.1	85.0
MTD18256	27.5	12.5	60.0	13.7*	0.66*	84.7	31.0	-3.1	4.5	210.0	78.5
MTD18217	26.0	11.9	62.1*	13.2	0.64	84.9	32.0	-3.4*	4.7*	232.9*	95.0*
MTD18266	26.4	12.8	60.8	13.6*	0.66	85.0	29.8	-3.1	3.5	165.1	64.5
MTD18148	26.2	12.9	60.8	13.2*	0.66*	84.5	32.0	-3.0	4.4	207.5	94.0*
MTD18313	25.7	12.4	61.9*	12.8	0.60	84.9	29.5	-2.9	3.9	176.8	68.0
Average	26.6	12.0	61.4	13.2	0.64	85.0	30.6	-3.1	3.8	182.4	76.7
Prob>F	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
LSD(0.05)	0.7	0.4	0.8	0.5	0.02	0.2	0.6	0.10	0.3	17.9	10.4
CV(%)	2.6	3.4	1.4	4.1	3.7	0.2	1.9	-3.2	8.4	10.0	6.6

¹Reported on a 14% moisture basis

²Only two locations (Bozeman dryland and NARC dryland) were measured.

** Indicates highest entry within a column.

* Indicates entries ranking equal to the highest entry based on Fisher's Unrestricted LSD at the 0.05 probability level.