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MEMORANDUM

FROM: Traci Hoogland, Greg Lutgen and Jamie Sherman, SpringBarley

DATE: January 4, 2022

RE: Release of MT Cowgirl (MT16F02902) spring forage barley

Pedigree: LAVINA/CDC COWBOY

Recommendation: Public, protected

Name: MT Cowgirl (MT16F02902)

Summary:

MT16F02902 is well-suited for production across all forage barley growing regions of Montana and is being released due to forage yield performance.

Agronomic Strengths

- High performing forage line
- Taller plant height
- Longer grain fill period
- Higher percentage of plump seed

Quality Strengths

- Potential improvement of forage quality with lower NDF and ADF

Selection history:

MT16F02902 is a spring, 2-row, hulled, hooded barley developed for forage barley production in Montana. MT16F02902 has a tall, erect growth habit, lax head type, rough awns, white aleurone and long rachilla hairs. MT16F02902 is an F4 derived selection from Lavina by CDC Cowboy cross. 'Lavina' (MT981397), one of the top barley forage producers in the state, is a two rowed hooded spring barley and is a cross between 'Haybet' and 'Baronesse'. 'Haybet' (P.I.533600), developed by USDA-ARS and the Montana Experiment Station. CDC Cowboy is a dual-purpose feed forage line with awns and produces well across environments in the Great Plains. MT16F02902 was advanced by single seed descent from the F1 thru F4 generations. It was increased from a F4 plant to produce seed for preliminary yield testing in 2016. MT16F02902 was tested for agronomic and forage traits beginning in 2017.

Purification/seed stocks:

We purified MT16F02902 in 2021 by planting 100 F9-derived F10 headrows at Bozeman Post farm. We evaluated for phenotypic uniformity before bulking all headrows. The 2021 breeder strips appeared uniform and were regularly rogued by barley breeding employees and Foundation staff. MT16F02902 will be in Foundation seed in 2022.

Agronomic performance and characteristics:

Table 1 compares MT16F02902 to control varieties Haymaker, Hays and Lavina. Across all environments, MT16F02902 was equal to or better than controls for forage yield and grain yield. MT16F02902 is taller than the controls, which likely supports forage yields. When MT16F02902 is compared to commonly grown lines it tends to head earlier and mature later such that it has a longer grainfill. The extended grainfill likely increases plump seed and might extend harvest flexibility. Seed size stability under dryland conditions could be important to seed production stability. MT16F02902 is not significantly different in percent grain protein and tends to have better quality with lower ADF and NDF although not significant.

Table 1: Comparison of MT16F02902 with Varietal Controls

TRAIT	CONTROL VARIETY	MT16F02902 MEAN	Control MEAN	MT16F02902/ CONTROL (%)	NUMBER OF OBSERVATIONS
FORAGE YIELD (TONS/ACRE)	Haymaker	3.81	3.53	107.7	12
	Hays	3.72	3.41	109.0*	21
	Lavina	3.72	3.59	103.7	22
GRAIN YIELD (BUSHEL/ACRE)	Haymaker	99.68	96.85	102.9	4
	Hays	87.94	91.97	95.6	13
	Lavina	87.94	89.05	98.7	13
HEADING DATE JULIAN	Haymaker	179.84	180.69	99.5*	10
	Hays	181.15	182.93	99.0***	19
	Lavina	181.83	181.71	100.1	23
MATURITY DATE JULIAN	Haymaker	201.48	200.56	100.5	5
	Hays	207.64	208.37	99.7	9
	Lavina	207.18	205.59	100.8**	10
HEIGHT (CM)	Haymaker	73.49	69.8	105.3**	12
	Hays	76.19	68.07	111.9***	21
	Lavina	73.79	69.25	106.6***	30
GRAIN PROTEIN (%)	Haymaker	12.74	13.2	96.5	6
	Hays	12.52	12.49	100.2	11
	Lavina	13.63	13.62	100.0	16
ADF	Haymaker	31.98	33.19	96.4	11
	Hays	34.07	33.61	101.4	19
	Lavina	33.92	33.98	99.8	20
NDF	Haymaker	57.72	59.67	96.7	11
	Hays	57.52	57.78	99.5	19
	Lavina	57.53	58.13	99.0	20
Plumps (% 6/64)	Haymaker	84.9	72.1	117.8	1
	Hays	84.9	80.6	105.3	1
	Lavina	64.6	58.27	110.9*	7

Difference indicated by Ttest at *p<0.05, **p<0.01, ***p<0.001

The trials in 2020 and 2021 were lattice square designs with 25 entries and 3 replications. Due to planting issues in several locations in 2018 and 2019 the trials had to be analyzed with a randomized complete block design that consisted of 16 entries and 3 replications. Due to the difference in design the trials are averaged over the years with similar design. Therefore, the tables below report agronomic data by location averaged across 2020 and 2021, as well as 2018 and 2019. The more powerful lattice square design indicates MT16F02902 has more tons/acre in most environments. In most environments where the difference is not significant, MT16F02902 trends equal to or better than most lines. Across environments MT16F02902 trends taller and earlier heading. The greater height in some part explains the greater tons/acre. The earlier heading may explain the more plump seed reported in Table 1. Importantly, the dataset is not balanced with some locations being lost for a variety of reasons, particularly for grain yield. MT16F02902 tends to be equal in grain yield to Lavina and Hays, while in some environments better than Haymaker. Improved grain yield performance in Bozeman suggests the best environment for seed production.

Agronomic data 2020-2021 Forage Intrastate Trial

Lattice square design, 25 entries, 3 replications

Variety	Tons/Acre						
	Bozeman	Conrad	Havre	Kalispell	Moccasin	Sidney	All Locations
loc years	2	1	2	2	1	1	9
Hays	4.54	3.05	1.87	4.87	4.69	1.61	3.76
Haymaker	4.72	3.32	2.03	4.94	4.83	1.92*	3.61
Lavina	4.98	3.02	1.98	5.84	4.77	1.96**	3.78
MT16F02902	4.71	3.12	2.91**	7.85**	5.76**	1.86*	4.19**
LSD (0.05)	0.82	0.55	0.24	1.50	0.14	0.31	0.38

Variety	Height						
	Bozeman	Conrad	Havre	Kalispell	Moccasin	Sidney	All Locations
loc years	2	1	2	2	2	1	10
Hays	68.4	63.3	55.1	75.0	59.6	72.1	66.2
Haymaker	71.8	66.8	58.9	82.3**	66.3	76.3*	71.52*
Lavina	72.1	64.5	56.8	79.3*	64.0	74.8	69.3*
MT16F02902	72.8	67.6	66.6**	80.5*	71.5**	81.1**	74.1**
LSD (0.05)	5.2	5.7	4.0	6.4	4.4	5.7	6.0

Variety	Grain Yield						
	Bozeman	Conrad	Havre	Kalispell	Moccasin	Sidney	All Locations
loc years	2	1	1	2	1	1	8
Hays	113.6**	66.8*	34.0	101.0**	83.7	62.6	87.8
Haymaker	102.6	49.0	32.9	97.6*	84.5	49.6	80.6
Lavina	104.2*	67.6**	46.2**	98.2*	90.3**	79.7**	90.0
MT16F02902	110.4*	60.6*	30.2	85.9	68.9	75*	83.3
LSD (0.05)	10.0	14.3	3.1	11.3	3.0	7.2	12.8

** indicates highest value within a column, if significantly different from other selected varieties

* indicates value equal to highest value within a column based on Fisher's Protected LSD (p=0.05)

No designated values within a column indicates that there is no significant difference between selected varieties

Variety	Heading						
	Bozeman	Conrad	Havre	Kalispell	Moccasin	Sidney	All Locations
loc years	2	1	2	1	1	1	8
Hays	179.0	191.7	177.3	194.3	187.2	181.1	184.8
Haymaker	178.5	190**	176.0	191.8	186.0*	177.9	184.4
Lavina	177.5*	191.0	172.5**	194.2	184.4**	175.9**	183.3*
MT16F02902	177.3**	190.3*	173.16*	192.2	185.7*	176.6*	182.93**
LSD (0.05)	0.86	0.94	1.28	5.47	1.76	1.74	0.79

** indicates lowest value within a column, if significantly different from other selected varieties

* indicates value equal to lowest value within a column based on Fisher's Protected LSD (p=0.05)

No designated values within a column indicates that there is no significant difference between selected varieties

Agronomic data 2018-2019 Forage Intrastate Trial
Randomized Complete Block Design, 16 entries, 3 replications

Variety	Tons/Acre					
	Bozeman	Conrad	Havre	Moccasin	Sidney	All Locations
loc years	2	1	2	2	2	9
Hays	5.70	3.16	3.65	2.34	2.29	3.46
Lavina	5.63	3.29	3.89	2.40	2.43	3.56
MT16F02902	5.93	4.43**	3.64	2.22	2.22	3.72
LSD (0.05)	0.96	0.93	0.61	0.40	0.50	0.90

Variety	Grain Yield					
	Bozeman	Conrad	Havre	Moccasin	Sidney	All Locations
loc years	2	1	1	2	2	8
Hays	137.6**	94.1	11.47**	58.8	99.3*	85.6
Lavina	121.9	73.5	8.6	64.6	105.2**	86.2
MT16F02902	128.7*	75.9	9.6	60.7	92.2	77.7
LSD (0.05)	11.1	45.6	1.7	9.8	10.4	10.6

Variety	Height					
	Bozeman	Conrad	Havre	Moccasin	Sidney	All Locations
loc years	2	1	2	2	2	9
Hays	84.0	65.2	62.4	68.3	70.7	70.1
Lavina	84.1	74.5	69.01**	70.7*	73.0	75.2*
MT16F02902	91.8**	82.1**	65.2	74.0**	80**	79.5**
LSD (0.05)	2.5	7.0	3.5	4.6	4.8	4.8

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* indicates value equal to highest value within a column based on Fisher's Protected LSD (p=0.05)

No designated values within a column indicates that there is no significant difference between selected varieties

Variety	Heading					
	Bozeman	Conrad	Havre	Moccasin	Sidney	All Locations
loc years	2	1	2	2	2	9
Hays	185.5	188.0	174.8**	189.3	178.0	183.1
Lavina	184.2**	188.0	175*	187.2**	176.0**	185.6
MT16F02902	184.5*	181.3**	177.8	188.3*	177.7	179**
LSD (0.05)	0.84	6.60	1.07	1.26	1.52	1.92

** indicates lowest value within a column, if significantly different from other selected varieties

* indicates value equal to lowest value within a column based on Fisher's Protected LSD (p=0.05)

No designated values within a column indicates that there is no significant difference between selected varieties

Disease resistance:

MT16F02902 is being tested in 2022 for stripe rust, since a relative has been found stripe rust resistant.

Cowgirl Stem Rust Data

2020 Study	Location	Njoro, Kenya		Debre Zeit, Ethiopia		
	Org.	KALRO/CIMMYT		EIAR		
	Date	4/20	4/27	5/22	5/30	6/8
Entry name		Stem Rust	Stem Rust	Stem Rust	Stem Rust	Stem Rust
MT16F02902		1 MS	5 M	5 MS	15 S	20 MS
Hays		5 MS	10 MS	5 MS	15 S	30 MS
Lavina		1 MS	5 M	10 MS	20 S	30 MS
AC Metcalfe		10 MS	15 M	0	5 MS	10 MS
ABI Voyager		15 MS	20 S	5 M	20 MS	60 S
MT16F02910		1 MS	10 M	1 MS	10 S	20 MS
MT16F02903		5 MS	10 M	10 MS	20 S	30 MS

R = Resistant

MR = Moderately Resistant

M = Intermediate

MS = Moderately Susceptible

S = Susceptible

MSU Barley Breeding Program:

Jamie Sherman, PI

MSU Breeding Staff – Greg Lutgen, Traci Hoogland, Joe Jensen, Jessica Williams, and Trevor Palone.

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