MONTANA STATE UNIVERSITY
MONTANA AGRICULTURAL EXPERIMENT STATION

RESULTS OF AGRONOMIC, CROPPING SYSTEMS AND WEED SCIENCE RESEARCH CONDUCTED IN SOUTH CENTRAL MONTANA – 2020

The Annual Report of the Investigations at and Administration of the Southern Agricultural Research Center, Huntley, Montana

PROJECT TITLE: Irrigated Hybrid Grain Corn Performance Trial near Huntley, Montana. (Exp. 201309).

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OBJECTIVES: To provide corn growers in south central Montana with a reliable, unbiased, up-to-date source of information that will permit valid comparisons among improved corn hybrids for irrigated grain production. This information should help corn producers in south central Montana select hybrids best suited to this region of the state.

METHODS: For 2020, seven private companies submitted 39 corn hybrids for testing under flood irrigated conditions near Huntley, Montana (Table 1). Thirty-five of the hybrids entered in the 2020 trial were genetically modified for both insect resistance and herbicide tolerance. Relative maturity ratings varied from 78 to 99 days. The study was planted using an alpha-lattice design with four replications. Test plots consisted of a 30-foot, 4-row plot with 30-inch row spacing. Each 30-foot row was planted with 69 seeds, equal to planting 40,075 seeds per acre or about 105 percent of the target population of 38,200 plants per acre. Planting depth was set at 1½ inches deep. Plot stands were determined by counting the number of established plants along the two center rows at approximately the 4 to 5 leaf stage of crop development. All rows of each test plot were subsequently trimmed 36 inches. The center two rows of each plot were harvested using an experimental-plot combine. Test weight (pounds per bushel) and percent grain moisture content were obtained for each plot using a Dickey-john GAC 2100 grain analyzer. Test weight is reported for grain sampled immediately after harvest on an "as-is" moisture basis. Grain protein, oil, and starch content were estimated by near-infrared reflectance using a Perten IM9500+ NIR spectrometer and adjusted to 100 percent dry matter content. Recorded grain yields were adjusted to 15.5% grain moisture content, and are reported in bushels per acre based on a 56-pound standard bushel weight.

RESULTS and SUMMARY: Conditions were colder than average during April of 2020, but were close to average through the rest of the spring and summer. Precipitation was below average for April and May, was well above average for June, and was below average for July and August (Table 2). Below average winter snowfall and precipitation in the spring led to drier surface soil moisture conditions at planting, delaying emergence and establishment, however above average precipitation in June facilitated the early growth of the corn. Planted on May 1st, the germinating corn seedlings were just below the soil surface during the last freezing date (May 9th) experienced in the spring of 2020. Final crop establishment eventually averaged 92 percent with hybrids varying from 85 to 97 percent (Table 3).

The frost-free period for the 2020 growing season at Huntley spanned from May 10th to September 9th, resulting in a 123-day growing season (Table 2). This interval is 5 days shorter than the normally expected frost-free period at this location. Total accumulated heat units (1,970 ºF, GDD_{corn}) for the season were 3 ºF cooler than the heat units normally expected to accumulate on average for this 123-day interval, and 4 percent below the level of heat units normally expected to accumulate during a typical 128-day frost-free growth period. June growing conditions were warmer

with greater than average precipitation, and July growing conditions were normal with less than average precipitation during crop irrigation. All hybrids had achieved some level of physiological maturity (*aka*, kernel black layer) by the middle of September when killing frost occurred. Later maturing hybrids all possessed black layer development for kernels at or near the base of the ears but usually lacked black layer for kernels examined at the far or distal end of the ears. The subsequent drying period was prolonged due to precipitation. Minimal lodging was evident prior to harvest in 2020, but significant feeding damage by birds was evident among some hybrids (Table 3). The amount of damage varied from 0 (zero) for several hybrid entries to 24 % damage on at least 50 percent of the ears of 'Croplan 2288VT2P/RIB'. In most cases, the higher degree of damage was associated with hybrids that 1) kept ears in an erect position at maturity, 2) developed ears that extended well beyond the protection of the wrapper leaves, or 3) produced ears with a combination of both traits.

Harvested on November 4th and 5th, harvest grain moisture content averaged 16 percent (Table 3), 50 percent drier than the similar set of plots harvested in 2018. Adjusted corn grain yields averaged 247.6 bushels per acre in 2020. Yields among the 39 entries in 2020 varied from 195.6 bushels per acre for the hybrid 'Simplot A7988' to 290.8 bushels per acre for the hybrid 'Northrup King NK9227-3220A.' Eight other hybrid corn entries produced averaged grain yields from 266.5 to 284.6 bushels per acre, which were statistically equal to the yield of the highest yielding hybrid tested in 2020. Test weight measured from grain averaged 57.4 lb/bu for the 39 entries, and varied from 54.2 lb/bu for 'Dekalb DKC 44-80' to 60.2 lb/bu for 'Simplot B8548.' Five of the 39 hybrid corn entries possessed a test weight value less than 56 lb/bu at harvest. Grain protein, oil, and starch content averaged 9.1, 3.7, and 71.7 percent, respectively.

Table 1. Contact information for seed sources of 39 hybrid corn entries tested at the MSU Southern Agricultural Research Center near Huntley, Montana during 2020.

Brand	Hybrids	Contact
Croplan	X19090VT2P 2790VT2P 2851VT2P 2965VT2P 3314VT2P 3575VT2P	Mr. Curt Droogsma Croplan by Winfield United Billings MT 59105 PH: 406-860-1330 EM: cddroogsma@landolakes.com
DeKalb	DKC 31-85 DKC 37-50 DKC 40-45 DKC 42-04 DKC 43-75 DKC 44-80 DKC 45-65	Mr. David Heimkes Bayer Cropscience Emmett ID 83617 PH: 320-444-3186 EM: david.heimkes@bayer.com
Dyna-Gro	D27VC87 D32VC41 D34VC54 D35VC35 D39VC40	Mr. Chris Hummel Dyna-Gro Seed / Nutrien Ag Bowling Green, MO 63334 PH: 573-470-1499 EM: chris.hummel@nutrien.com
Hi Fidelity Genetics	HFG0851 HFG0852 HFG0921 HFG0951	Ms. Rachel Greenhut Hi Fidelity Genetics Durham, NC 27701 PH: 530-574-3135 EM: rachel.greenhut@hifidelitygenetics.com
AMP Bravo	A7837 VT2PRIB A7988 VT2PRIB A8338-VT2PRIB A8367-VT2PRIB B8548-RR	Ms. P.J. Stevens Simplot Grower Solutions 3192 E. 49th N. Idaho Falls, ID 83401 PH: 208-351-2521 EM: phylipa.stevens@simplot.com
Northrup-King	NK8005-GTA NK8519-3220 NK8618-3120A NK8881-3120A NK9175-3110A NK9227-3220A	Lenard Womack Syngenta Buhl, ID 83316 PH: 208-616-5710 EM: len.womack@syngenta.com
REA Hybrids	1B821 2B851 2B861 3B903 3B912 3B923	Jon Langan REA Hybrids Laporte, MN 56461 PH: 701-535-1006 EM: jonathan.langan@bayer.com

Table 2. Summary of climatic data by months for the 2019-2020 cropping year (September-August) compared to averages for the period of record from 1911 to 2019 at the Southern Agricultural Research Center near Huntley, Montana.

	2019				2020								
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Year
Precipitation (inches)													Total
Current Year (2019-2020)	3.66	1.00	0.81	0.50	0.17	0.46	0.69	0.79	1.58	4.75	0.00	0.72	15.13
Average (1911-2019)	1.33	1.10	0.63	0.61	0.55	0.48	0.80	1.38	2.23	2.31	1.13	0.97	13.52
Difference	2.33	-0.10	0.18	-0.11	-0.38	-0.02	-.11	-0.59	-0.65	2.44	-1.13	-0.25	1.61
Mean Temperature (ºF)													Average
Current Year (2019-2020)	59.8	37.2	32.2	28.3	24.6	26.8	35.8	40.3	54.9	65.3	70.4	71.4	45.58
Average (1911-2019)	58.1	46.8	33.7	23.9	21.0	25.5	34.2	45.5	54.9	63.4	70.8	68.8	45.55
Difference	1.7	-9.6	-1.5	4.4	3.6	1.3	1.6	-5.2	0.0	1.9	-0.4	2.6	0.03

Last Killing Frost in Spring[1/]
2020 ..... 32 ºF on May 9
Average (1911-2019) ..... May 16

First Killing Frost in the Fall[1/]
2020 ..... 31 ºF on September 9
Average (1911-2019) ..... September 21

Frost-free Period
2020 ..... 123 days
Average (1911-2019) ..... 128 days

Growing Degree Days (Base 50)[2/]
2020 ..... 2,028 GDD (ºF)
Average (1911-2019) ..... 1883 GDD (ºF)

Growing Degree Days (Base Corn)[2/]
2020 ..... 1,970 GDD (ºF)
Average (1911-2019) ..... 1,973 GDD (ºF)

Maximum Summer Temperature
102 ºF on August 18, 2020

Minimum Winter Temperature
-22 ºF on January 18, 2020

1/ 32 ºF is considered a killing frost. Average last and first killing frost dates are calculated on a 50% probability of a minimum temperature occurring below the threshold temperature of 32.5 ºF based on observations from 1911 to 2019.

2/ Growing degree days calculated from temperatures observed during the frost free period from May 10th through September 9th, 2020, and for the same 123-day interval from the period of record of 1911 to 2019.

Table 3. Agronomic performance of 39 commercial corn hybrids grown under irrigated conditions near Huntley, Montana during 2020. Sorted by brand & hybrid. MSU Southern Agricultural Research Center.

Brand & Hybrid	RM	Grain[1/] Yield	Test[2/] Weight	Grain Moisture	Grain[3/] Protein	Grain[3/] Oil	Grain[3/] Starch	Crop Establishment		Silking Date		Tasseling Date		Bird[4/] Damage
								Stand	Emergence	Julian	Calendar	Julian	Calendar	
	- days -	- bu/a -	- lb/bu -	- % -	---------- % ----------			- plants/a -	- % -	- days -	- date -	- days -	- date -	- % -
AMP A7837 VT2PRIB	78	202.4	59.3	13.8	10.3	3.8	70.5	37,611	93.9	203.3	Jul 22	202.5	Jul 22	20.9
AMP A7988 VT2PRIB	79	195.6	59.5	14.1	9.8	3.9	70.8	36,833	91.9	200.7	Jul 20	199.0	Jul 18	23.9
AMP A8338-VT2PRIB	83	230.3	59.1	14.9	8.9	3.6	72.0	36,393	90.8	203.5	Jul 23	202.5	Jul 22	12.2
AMP A8367-VT2PRIB	83	215.4	59.4	14.1	8.9	4.1	71.3	35,214	87.9	204.7	Jul 24	204.0	Jul 23	9.5
Bravo B8548-RR	85	252.9	60.2	14.3	9.4	3.7	71.5	37,639	93.9	204.5	Jul 24	203.5	Jul 23	3.5
Croplan 2790VT2P	87	226.8	57.1	15.4	9.0	3.8	71.5	37,606	93.8	205.0	Jul 24	205.0	Jul 24	8.8
Croplan 2851VT2P	88	260.6	57.1	15.4	9.4	3.7	71.4	37,938	94.7	205.5	Jul 25	205.2	Jul 24	4.2
Croplan 2965VT2P	89	262.2	57.7	15.0	9.4	4.0	70.9	36,782	91.8	205.8	Jul 25	205.3	Jul 24	9.0
Croplan 3314VT2P	93	251.8	55.1	17.9	9.1	3.5	72.2	36,998	92.3	205.5	Jul 25	205.3	Jul 24	4.6
Croplan 3575VT2P	95	**278.7***	57.0	14.7	9.3	3.3	72.4	37,118	92.6	208.8	Jul 28	208.5	Jul 28	2.8
Croplan X19090VT2P	90	257.4	56.4	15.3	9.2	3.4	72.0	38,446	95.9	205.0	Jul 24	205.3	Jul 24	6.7
Dekalb DKC 31-85	81	217.9	58.2	14.3	9.7	4.1	70.7	36,733	91.7	202.7	Jul 22	202.8	Jul 22	20.5
Dekalb DKC 37-50	87	240.8	57.7	14.3	9.6	3.9	70.9	35,583	88.8	204.5	Jul 24	203.7	Jul 23	7.5
Dekalb DKC 40-45	90	231.8	56.8	15.6	8.9	3.5	72.0	35,619	88.9	206.7	Jul 26	206.5	Jul 26	9.6
Dekalb DKC 42-04	92	**281.7***	56.0	17.5	8.8	3.7	72.1	38,202	95.3	206.8	Jul 26	206.4	Jul 25	1.5
Dekalb DKC 43-75	93	261.4	56.4	16.2	8.4	4.0	72.0	37,326	93.1	207.5	Jul 27	206.7	Jul 26	1.7
Dekalb DKC 44-80	94	236.2	54.2	17.6	8.2	3.6	72.7	34,614	86.4	207.3	Jul 26	208.3	Jul 27	2.7
Dekalb DKC 45-65	95	**268.2***	55.5	16.8	8.9	3.9	71.9	38,013	94.9	207.3	Jul 26	207.0	Jul 26	4.6
Dyna-Gro D27VC87	87	241.4	57.9	15.3	8.9	3.8	71.6	34,472	86.0	205.0	Jul 24	204.2	Jul 23	7.7
Dyna-Gro D32VC41	92	256.1	57.7	15.8	9.0	4.1	71.2	38,986	97.3	208.0	Jul 27	207.8	Jul 27	2.3
Dyna-Gro D34VC54	94	**266.5***	55.3	17.2	8.7	3.6	72.4	37,733	94.2	205.0	Jul 24	205.3	Jul 24	5.5
Dyna-Gro D35VC35	95	245.4	58.8	15.0	8.9	3.7	71.8	36,284	90.5	205.5	Jul 25	205.0	Jul 24	4.0
Dyna-Gro D39VC40	99	**269.6***	56.7	15.1	9.4	4.0	71.6	35,120	87.6	209.8	Jul 29	209.8	Jul 29	1.8
HFG 0851	85	208.7	60.1	15.0	9.0	3.5	72.1	34,110	85.1	204.0	Jul 23	203.0	Jul 22	9.8
HFG 0852	85	245.9	57.2	16.5	9.1	3.4	72.2	36,604	91.3	204.8	Jul 24	204.9	Jul 24	10.0
HFG 0921	92	257.1	56.9	16.0	8.7	3.9	71.9	35,880	89.5	208.5	Jul 28	208.0	Jul 27	2.6
HFG 0951	95	217.6	55.0	17.9	8.6	3.8	72.4	34,982	87.3	207.3	Jul 26	207.0	Jul 26	7.4
Northrup King NK8005-GTA	80	245.2	60.0	15.2	9.4	3.8	71.5	37,181	92.8	204.0	Jul 23	203.0	Jul 22	5.4
Northrup King NK8519-3220	85	257.5	58.3	15.1	9.8	3.7	71.2	35,968	89.8	207.7	Jul 27	206.9	Jul 26	3.0
Northrup King NK8618-3120A	86	254.5	58.1	15.8	9.6	3.7	71.4	36,455	91.0	207.2	Jul 26	206.7	Jul 26	2.7
Northrup King NK8881-3120A	88	255.4	56.9	16.6	9.3	3.1	72.4	36,403	90.8	206.2	Jul 25	206.0	Jul 25	0.0
Northrup King NK9175-3110A	91	**269.1***	56.6	16.3	8.3	3.5	72.5	37,988	94.8	207.7	Jul 27	208.9	Jul 28	1.6
Northrup King NK9227-3220A	92	**290.8****	57.1	14.9	10.2	3.2	71.7	37,688	94.0	209.5	Jul 29	209.0	Jul 28	1.3
REA 1B821	82	214.0	57.2	15.3	9.4	4.2	70.8	34,435	85.9	204.7	Jul 24	204.7	Jul 24	15.4
REA 2B851	85	227.0	58.9	14.3	9.0	4.0	71.3	37,375	93.3	203.7	Jul 23	203.3	Jul 22	15.8
REA 2B861	86	238.7	57.3	15.9	8.4	3.7	72.2	34,523	86.1	205.0	Jul 24	203.3	Jul 22	5.0
REA 3B903	90	**284.6***	57.8	15.5	9.2	3.5	71.9	37,837	94.4	205.7	Jul 25	205.5	Jul 25	2.5
REA 3B912	91	**270.2***	56.9	16.3	9.3	3.3	72.1	37,425	93.4	206.5	Jul 26	206.8	Jul 26	4.3
REA 3B923	92	**271.0***	57.0	16.2	8.9	3.8	71.7	37,389	93.3	206.0	Jul 25	206.0	Jul 25	1.6

Average	247.6	57.4	15.6	9.1	3.7	71.7	36,654	91.5	205.8	Jul 25	205.5	Jul 25	6.8
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 (p=0.05)	26.5	1.3	2.0	0.4	0.2	0.4	2,276	5.7	1.1		1.0		4.4
CV%	7.3	1.6	9.2	3.3	3.8	0.4	4.2	4.2	0.4		0.3		44.0
Lattice RE%[5/]	105	101	100	100	101	101	111	111	100		100		109

** Indicates highest yielding hybrid.

* Indicates hybrids yielding equal to highest yielding hybrid based on Fisher's protected LSD (p=0.05).

[1]/ Yields in bushels per acre are based on a 56-pound standard bushel weight for corn and adjusted to 15.5 percent moisture content.

[2]/ Grain test weight determined on an "as-is" harvest moisture basis.

[3]/ Grain protein, oil and starch content adjusted to 100 percent dry matter content.

[4]/ Bird damage visually estimated as the percent feeding damage occuring to at least 50% of the ears.

[5]/ Adjusted means provided for Lattice RE% values equal to or greater than 100%.

Planted: May 1, 2020
Harvested: November 4 and 5, 2020
Previous crop: Spring Barley
Fertility: 73.0 lb/a residual soil NO3-N + 250 lb/a N as Urea
Herbicide: Prowl 3.3 EC 32 oz/a, Outlook 16 oz/a, Liberate 6 oz/a May 2, 2020
Insecticide: Mustang Maxx 4 oz/a August 3, 2020
Irrigation: Flood, July 7, July 21-22, August 10, August 24
Precipitation (planting to harvest): 9.66 inches