The MONTANA STATE UNIVERSITY
MONTANA AGRICULTURAL EXPERIMENT STATION

RESULTS OF AGRONOMIC, CROPPING SYSTEMS AND WEED SCIENCE RESEARCH CONDUCTED IN SOUTH CENTRAL MONTANA – 2018

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. 181309).

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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 2018, four private companies submitted 30 corn hybrids representing five brands for testing under flood irrigated conditions near Huntley, Montana (Table 1). All of the hybrids entered in the 2018 trial were genetically modified for both insect resistance and herbicide tolerance. Relative maturity ratings varied from 82 to 98 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, and also for grain dried below a threshold value of 15.5 percent moisture content. 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 March and April of 2018, but rose above average for May, while precipitation was well above average throughout most of the growing season (Table 2). Record winter snowfall and the above average precipitation in the spring led to above average surface soil moisture conditions at planting, facilitating quick emergence, establishment and early growth of the corn. The last freezing date in the spring of 2018 (April 25th), occurred before planting on May 14th. Final crop establishment eventually averaged 91 percent with hybrids varying from 86 to 95 percent (Table 3).

The frost-free period for the 2018 growing season at Huntley spanned from April 25th to September 21st, resulting in a 149-day growing season (Table 2). This interval is 24 days longer than the normally expected frost-free period at this location. Total accumulated heat units (2,199 ºF, GDD_{corn}) for the season were 29 ºF cooler than the heat units normally expected to accumulate on average for this 149-day interval, and 1 percent below the level of heat units normally expected to accumulate during a typical 125-day frost-free growth period. June and July

growing conditions were normal with greater 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 2018, 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 23 % 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 October 24th and 25th, harvest grain moisture content averaged 24 percent (Table 3), 41 percent wetter than the similar set of plots harvested in 2017. Adjusted corn grain yields averaged 254 bushels per acre in 2018. Yields among the 30 entries in 2018 varied from 278 bushels per acre for the hybrid 'Rob-See-Co RC3834' to 190 bushels per acre for the hybrid Croplan 2288VT2P/RIB. Six other hybrid corn entries produced averaged grain yields from 264.6 to 274.0 bushels per acre, which were statistically equal to the yield of the highest yielding hybrid tested in 2018. Test weight measured from grain dried below 15.5 percent moisture content averaged 54.1 lb/bu for the 30 entries, and varied from 51.1 lb/bu for 'Rob-See-Co RC4848' to 57.2 lb/bu for Croplan 2288VT2P/RIB. Twenty-eight of the 30 hybrid corn entries possessed a test weight value less than 56 lb/bu at grain moisture levels below 15.5 percent. Grain protein, oil, and starch content averaged 9.0, 3.8, and 71.5 percent, respectively.

Table 1. Contact information for seed sources of 30 hybrid corn entries tested at the MSU Southern Agricultural Research Center near Huntley, Montana during 2018.

Brand	Hybrids	Contact
Croplan	2288VT2P/RIB 2692AS3011A 2965VT2P/RIB 2790VT2P/RIB 3314VT2P/RIB 3499VT3P/RIB 3575VT2P/RIB X18093AVT2P/RIB X18095B/VT2P X18095C/VT2P	Mr. Curt Droogsma Croplan by WinField United 406 Cherry Hills Road Billings MT 59105 PH: 406-860-1330 EM: cddroogsma@landolakes.com
DeKalb	DKC 36-30 DKC 37-86 DKC 39-27 DKC 40-78 DKC 42-05 DKC 44-80 DKC 45-65	Mr. David Heimkes Monsanto Company Emmett ID 83617 PH: 320-444-3186 EM: david.heimkes@monsanto.com
Innotech Rob-See-Co	IC4016 IC4286 IC4759 RC3601 RC3834 RC4343 RC4848	Mr. Dan Story Rob-See-Co 707 Golf Course Road Laurel MT 59044 PH: 406-697-6084 EM: dstory@robseeco.com
Legend	47J185-GT/CB/LL 47J988-3120 LR9492-VT2PRIB LR97A89-3011A LR98A84-3010A LR9886VT2PRIB	Ms. P.J. Stevens Simplot Grower Solutions 3192 E. 49th N. Idaho Falls, ID 83401 PH: 208-351-2521 EM: phylipa.stevens@simplot.com

Table 2. Summary of climatic data by months for the 2017-2018 cropping year (September-August) compared to averages for the period of record from 1911 to 2017 at the Southern Agricultural Research Center near Huntley, Montana.

	2017				2018								
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Year
Precipitation (inches)													Total
Current Year (2017-2018)	2.57	0.37	1.17	1.14	0.58	1.82	0.90	2.70	3.81	3.77	0.87	2.00	21.70
Average (1911-2016)	1.30	1.07	0.64	0.59	0.55	0.45	0.79	1.34	2.18	2.33	1.14	0.94	13.32
Difference	+1.27	-0.70	+0.53	+0.55	+0.03	+1.37	+0.11	+1.36	+1.63	+1.44	-0.27	+1.06	+8.38
Mean Temperature (ºF)													Average
Current Year (2016-2017)	58.6	47.0	33.6	23.4	19.6	9.9	29.3	40.7	59.1	63.4	70.2	67.8	43.6
Average (1911-2016)	58.0	46.9	33.6	23.9	20.7	25.7	34.3	45.5	54.9	63.3	70.8	68.8	45.5
Difference	+0.6	+0.1	0.0	-0.5	-1.1	-15.8	-5.0	-4.8	+4.2	+0.1	-0.6	-1.0	-1.9

Last Killing Frost in Spring[1/]
2018 ..... 32ºF on April 25
Average (1911-2017) ..... May 17

First Killing Frost in the Fall[1/]
2018 ..... 30ºF on September 21
Average (1911-2017) ..... September 19

Frost-free Period
2018 .....149 days
Average (1911-2017) ..... 125 days

Growing Degree Days (Base 50)[2/]
2018 ..... 2,138 GDD (ºF)
Average (1911-2017) ..... 2,009 GDD (ºF)

Growing Degree Days (Base Corn)[2/]
2018 ..... 2,199 GDD (ºF)
Average (1911-2017) ..... . 2,219 GDD (ºF)

Maximum Summer Temperature
100ºF on August 11, 12, and 13, 2018

Minimum Winter Temperature
-29 ºF on February 10 and 20, 2018

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 2017.

2/ Growing degree days calculated from temperatures observed during the frost free period from April 25 through September17, 2018, and for the same 145-day interval from the period of record of 1911 to 2017.

Table 3. Agronomic performance of 30 commercial corn hybrids grown under irrigated conditions near Huntley, Montana during 2018. Sorted by brand & hybrid. MSU Southern Agricultural Research Center.

			Harvest						Crop Establishment		Silking Date		Tasseling Date		
		Grain[1/]	Test[2/]	Grain	Test[3/]	Grain[4/]	Grain[4/]	Grain[4/]							Bird[5/]
Brand & Hybrid	RM	Yield	Weight	Moisture	Weight	Protein	Oil	Starch	Stand	Emergence	Julian	Calendar	Julian	Calendar	Damage
	- days -	- bu/a -	- lb/bu -	- % -	- lb/bu -	---------- % ----------			- plants/a -	- % -					- % -
Croplan 2288VT2P/RIB	82	190.0	52.9	20.5	57.2	10.3	4.3	69.9	36,733	91.7	201.0	Jul 19	201.7	Jul 19	22.7
Croplan 2692AS3011A	86	248.7	51.0	22.3	55.4	9.0	3.7	71.9	35,754	89.2	201.2	Jul 19	203.0	Jul 21	8.2
Croplan 2790VT2P/RIB	87	**268.8***	50.6	23.1	54.9	8.7	3.9	71.5	36,922	92.1	202.4	Jul 20	203.3	Jul 21	9.5
Croplan 2965VT2P/RIB	89	**266.1***	50.6	22.2	55.0	9.1	4.1	71.0	35,325	88.1	203.0	Jul 21	206.2	Jul 24	11.4
Croplan 3314VT2P/RIB	93	254.8	47.9	26.1	52.9	8.9	4.0	71.3	36,737	91.7	202.9	Jul 20	205.0	Jul 23	4.9
Croplan 3499VT3P/RIB	93	252.6	46.9	26.7	52.1	9.1	3.8	71.5	38,055	95.0	204.8	Jul 22	205.8	Jul 23	3.5
Croplan 3575VT2P/RIB	95	258.1	48.8	25.4	53.6	9.5	3.6	71.5	36,360	90.7	205.6	Jul 23	206.8	Jul 24	2.6
Croplan X18093AVT2P/RIB	93	258.4	49.5	24.0	53.6	8.7	3.9	71.6	35,424	88.4	205.2	Jul 23	205.4	Jul 23	4.1
Croplan X18095B/VT2P	95	249.2	50.3	24.8	54.3	8.1	3.7	72.3	34,560	86.2	202.8	Jul 20	204.0	Jul 22	8.0
Croplan X18095C/VT2P	95	**269.5***	48.3	24.6	53.6	8.6	3.9	71.6	36,179	90.3	203.0	Jul 21	203.7	Jul 21	8.0
Dekalb DKC 36-30	86	243.9	50.3	22.0	55.2	8.9	4.0	71.3	36,562	91.2	200.1	Jul 18	200.7	Jul 18	18.3
Dekalb DKC 37-86	87	244.3	51.0	22.3	55.8	8.5	3.8	71.8	35,432	88.4	200.5	Jul 18	201.3	Jul 19	12.8
Dekalb DKC 39-27	89	258.0	49.1	23.1	53.8	8.9	4.0	71.1	36,709	91.6	201.9	Jul 19	203.2	Jul 21	15.0
Dekalb DKC 40-78	90	245.3	52.6	20.7	55.7	8.8	3.8	71.5	37,262	93.0	202.6	Jul 20	202.5	Jul 20	10.5
Dekalb DKC 42-05	92	**274.0***	48.9	23.9	53.9	8.3	4.0	71.6	36,722	91.6	202.8	Jul 20	205.0	Jul 23	11.1
Dekalb DKC 44-80	94	**272.2***	48.3	24.1	52.6	7.8	4.0	72.2	35,912	89.6	204.4	Jul 22	206.0	Jul 24	10.8
Dekalb DKC 45-65	95	256.1	46.7	26.3	52.5	8.7	4.3	71.1	37,055	92.5	202.7	Jul 20	205.2	Jul 23	9.2
Innotech IC4016	90	255.2	48.2	24.4	52.7	9.7	3.6	71.1	35,645	88.9	203.5	Jul 21	204.5	Jul 22	0.0
Innotech IC4286	92	**264.6***	49.2	23.1	53.6	9.2	3.6	71.5	36,929	92.1	205.1	Jul 23	206.3	Jul 24	3.7
Innotech IC4759	97	242.8	47.8	25.0	52.9	10.0	3.6	71.0	36,836	91.9	205.1	Jul 23	205.3	Jul 23	1.5
Legend Seeds 47J185-GT/CB/LL	85	261.5	50.1	23.2	54.7	8.5	3.6	72.3	37,280	93.0	201.2	Jul 19	202.7	Jul 20	5.0
Legend Seeds 47J988-3120	88	255.8	48.3	23.7	53.1	9.2	3.5	71.7	35,363	88.2	203.4	Jul 21	205.2	Jul 23	0.0
Legend Seeds LR9492-VT2PRIB	92	254.0	48.6	25.7	54.4	8.8	4.1	71.2	36,046	89.9	205.2	Jul 23	206.0	Jul 24	1.6
Legend Seeds LR97A89-3011A	89	250.8	50.8	22.0	55.3	8.9	3.6	72.0	34,747	86.7	201.5	Jul 19	203.1	Jul 21	8.0
Legend Seeds LR9886VT2PRIB	86	251.2	49.9	23.4	53.9	8.9	4.1	71.2	37,428	93.4	203.2	Jul 21	205.0	Jul 23	13.6
Legend Seeds LR98A84-3010A	84	241.8	50.1	23.8	54.3	8.5	3.8	71.8	35,422	88.4	202.3	Jul 20	203.3	Jul 21	1.5
Rob-See-Co RC3601	86	247.9	51.4	21.5	56.1	8.9	3.7	71.9	35,924	89.6	201.4	Jul 19	202.2	Jul 20	3.6
Rob-See-Co RC3834	88	**278.2****	50.3	22.1	54.8	8.8	3.4	72.1	37,194	92.8	202.8	Jul 20	204.3	Jul 22	0.0
Rob-See-Co RC4343	93	250.2	48.3	24.5	53.2	9.9	3.3	71.4	37,110	92.6	205.9	Jul 23	206.6	Jul 24	0.1
Rob-See-Co RC4848	98	244.9	46.3	27.9	51.1	9.1	3.7	71.6	37,955	94.7	205.7	Jul 23	205.8	Jul 23	3.9
Average		253.6	49.4	23.7	54.1	9.0	3.8	71.5	36,386	90.8	203.1	Jul 21	204.3	Jul 22	4.9
Prob > F		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.286	0.286	<0.001		<0.001		<0.001
LSD (p=0.05)		13.6	1.2	1.0	1.0	0.4	0.2	0.4	ns	ns	1.4		1.4		1.6
CV%		3.6	1.6	2.8	1.3	3.1	3.4	0.4	4.3	4.3	0.5		0.5		0.5
Lattice RE%[6/]		112.5	102.7	101.8	102.3	100.0	100.0	100.2	111.0	111.0	104.9		101.0		102.1

** 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 test weight determined for wet grain (>15.5 %) dried below the threshold of 15.5 percent moisture content.

4/ Grain protein, oil and starch content adjusted to 100 percent dry matter content.

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

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

(over)

Table 3 Con't.

Planted: May 14, 2018
Harvested: October 24 & 25, 2018
Previous crop: Spring Barley
Fertility: 100-30-0 (200 lb/a), (plus 68 lb/a residual soil NO3-N)
Herbicide: AMS (1 lb/a) + Roundup PowerMax (32 oz/a) + Prowl 3.3EC (24 oz/a) + Outlook (16 oz/a), pre-emergence
Irrigation: Flood, July 9 & 10, July 23, August 2, August 16 & 17
Precipitation (planting to harvest): 10.68 inches