PROJECT TITLE: Evaluation of Seed Boot and Furrow Opener Configurations for Optimizing Seed and Fertilizer Placement in Simultaneous, Single-Pass Operations with Air Drills under Differing Cropping Systems.

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OBJECTIVES:

It is the objective of this project to evaluate air drill openers for the production of cereal grains under varying cropping conditions and systems in northern Montana.

RESULTS:

The agronomic performance of eleven "double-shoot" opener configurations under dryland chemical fallow conditions with `Scholar' spring wheat direct-seeded into spring wheat stubble at Havre in 2002 is presented in Table 1. The 'Morris Gumbo Boot' was included in the 2002 trial, but was deleted from final data analysis due to its' performance being adversely and unfairly affected by improper planting depth setting (slightly too deep) which under 2002 conditions resulted in substantial reduction in plant population). Although this opener's performance showed excellent recovery to this planting error under an abnormally cool and moist cropping environment, it was not deemed appropriate to compare its' overall performance relative to the other eleven entries which all had identical and shallower planting depths. Yield performance data for all air drill opener trials conducted by NARC-Agronomy since the investigations began in 1997 is presented in Table 2. A "5-Year, Comparable Average" summary for all openers evaluated in at least three of the five years (1998-2002) with spring wheat on mechanical or chemical fallow at Havre is presented in Table 3. Figures 1 through 12 comprise a post-harvest photo gallery for spring wheat plots established with openers evaluated in 2002.

SUMMARY:

Producers contemplating purchase of an air drill logically base their decisions on a number of variables to include manufacturer, dealer support, features, availability, price, etc. Prior to the past several years, limited attention was given the type and style of interchangeable openers supplied with a new or used air drill. In some situations, dealers want to encourage a prospective buyer to consider a particular type of opener thought to be most appropriate for the grower's own conditions and needs, but are reluctant to do so if less sophisticated and less costly openers being selected on a competitor's machine would result in loss of a sale. Due to the cost associated with outfitting a machine of average width with openers, producers prefer to limit their on-farm inventory to one or perhaps two differing scenarios to cover nearly all planting needs. Openers range widely in cost, but it is not uncommon for producers to spend an average of $100 per shank which amounts to $4000-$5000 for a typical air drill. Thus, few producers can afford to make very many selection mistakes in a "trial and error" approach before finding the opener most appropriate for them. Approximately 70% of the dryland wheat and barley in major producing areas of Montana is sown with air drills. Thus, producers are keenly interested in unbiased evaluation of air drill opener options.

Our involvement with air drill opener investigations began in 1997 when Northern Agricultural Research Center hosted the third Montana "Fields of Tomorrow" show sponsored by Monsanto Company and KMON Country Radio with trade show support of numerous other vendors of agricultural supplies, equipment and technology. Part of NARC's contract for hosting the show included on-site evaluation of air drill openers. The use of a research-scale `Concord' air drill was provided to Northern Agricultural Research Center by the manufacturer in cooperation with area dealer, Northern Ag Services of Malta. At the same time, a research-scale `Conserva-Pak' air drill was purchased by MSU for use in

conducting a series of large-scale cropping systems projects in Montana funded by USDA's Special Grant Program. Initially the MSU unit was available for inclusion in the opener evaluation studies at Havre and Moccasin. Heavy use schedules within the projects for which it was purchased have limited use of the Conserva-Pak in recent seed and fertilizer placement investigations. Carlson has conducted air drill opener investigations each year since 1997 with the Concord machine. Manufacturers and/or dealers provide all opener hardware at no cost to the Research Center.

Square-wall, 6-inch wide 'Titan' packer tires were utilized with all openers in 2001 and 2002 trials. Standard 165x15R radial packer tires were utilized with all openers in previous trials. The wider Titan packer tires afford more appropriate packing with opener scenarios featuring wider seed bands, but may be less appropriate than narrower packer tires for packing narrow seed band scenarios. Interchanging packer wheels/tires for different openers within a single trial is not feasible in view of the time and effort required.

The Concord unit is also integral to other research investigations conducted by Stougaard and Carlson involving the use of widened seed bands and increased rates of seeding for reduction of wild oat competition in the production of spring wheat. Carlson, Long and Stougaard are further involved in developing other crop and crop pest management strategies utilizing Variable Rate Technology (VRT) equipment added to the Concord with funds provided in part by the Montana Wheat and Barley Committee, Northern Agricultural Research Center and Northern Ag Services. Boss and Carlson are utilizing these technologies in yet a fourth collaborative effort where they are investigating the effects of barley class, variable seed band widths, variable seeding rates, and variable harvest end points on both forage and grain end use parameters.

FUTURE PLANS:

The Research Center plans to continue work with opener evaluations in response to continued interest expressed by Montana producers. New opener configurations have been incorporated into the trials during each of the past four years, and mid-row fertilizer banding capability was added for the 2001 investigations.

Stougaard and Carlson completed the third of three years of field research in 2001 evaluating the effects of seeding rate and placement patterns on spring wheat's ability to compete with wild oats. It was difficult to secure extramural funding support for the pilot studies in this effort. With positive results from the pilot studies in hand, the next phase will logically involve replicated, commercial field-scale application of the technology in the presence of 'already-established' wild oat populations. It will not be possible to carry out the next phase of this research without an appropriate level of extramural funding from some yet undetermined source. The general expense and time investment required cannot be absorbed by existing resources. The researchers will continue to pursue potential sources of funding.

Long, Carlson and Whitmus will continue other existing investigations underway with VRT-equipped air drills in site-specific placement of nitrogen for optimized yield and protein relationships in wheat.

Boss and Carlson completed the second of three (+?) years of field research in 2002 on, "Increasing Yield and Management Options for Producers who Traditionally Plant Barley for Forage or Grain Production." The second and third years of this work are supported by a grant with the Montana Board of Research and Commercialization Technology.

Thus, although originally put to work at Havre solely for the purpose of evaluating opener configurations – the Concord air drill is currently serving three (and potentially four) separate, but related research endeavors out of the Havre station.

TABLE 1. Comparison of "Double-Shoot" Air Drill Opener Configurations on 12" Spacings under Dryland Chemical Fallow Conditions wth `Scholar' Spring Wheat Direct-Seeded into Winter Wheat Stubble at Havre. Northern Agricultural Research Center. Havre, Montana. 2002. (Exp# 02-SP08-OP)

ENTRY	STAND %	1/ ROW STYLE	2/ SEED BAND Inches	PLANTS /FT2 No.	3/ CULMS /FT2 No.	CULMS /PLANT No.	4/ HEAD DATE Julian	PLANT HEIGHT Inches	5/ GRAIN YIELD Bu/Ac	GRAIN MOIST. %	TEST WEIGHT Lbs/Bu	6/ GRAIN PROTEIN %
FARMLAND LD w/Case-McKay 11" LD Swp & K3 B'kswpt Knf	99.6	2.0	6.8	10.7	33.3	3.2	188.3	26.6	40.4	11.6	61.6	16.2
FLEXICOIL STEALTH w/Paired Row Attachment	98.2	1.0	4.6	10.6	28.0	2.7	190.0	28.3	40.4	11.4	61.9	15.9
DUTCH SUPER EAGLE w/3.5" Paired Row Attachment	98.8	2.0	4.7	9.4	29.3	3.2	189.7	26.2	40.1	11.8	61.5	16.0
GEN T2x2	99.9	3.0	6.7	14.6	33.7	2.3	189.3	25.2	38.9	11.7	61.5	16.1
FARMLAND SB1-SBS1 w/6" Nichols Knock-On Swp & K3 Knife	99.6	2.0	6.1	11.6	28.3	2.5	188.3	25.6	38.8	11.3	61.6	16.3
DUTCH SUPER EAGLE w/5.5" Paired Row Attachment	99.5	3.0	7.2	10.1	27.0	2.8	190.3	26.3	38.4	11.9	61.8	16.0
ANDERSON (Case-Concord) Triple Shooter	99.6	2.0	4.8	13.6	27.9	2.1	190.0	26.6	38.1	11.5	61.9	15.7
FARMLAND LD w/Case-McKay 6" LD Swp & K3 B'kswpt Knife	99.1	2.0	6.8	13.4	31.8	2.6	189.3	26.7	38.1	11.7	61.5	16.4
ATOM JET (HarvesTechnologies) Side Band	98.6	1.0	2.9	11.7	23.9	2.1	189.3	26.6	37.9	11.8	61.6	16.1
DUTCH SUPER EAGLE w/FARMLAND Mid-Row Bnd'g Disks	100.0	1.0	2.1	18.3	27.6	1.5	188.7	26.8	36.8	11.9	61.6	16.3
ATOM JET (HarvesTechnologies) 4" Paired Row	99.6	3.0	5.5	12.0	27.7	2.4	188.7	26.1	36.5	11.6	61.0	16.4
EXPERIMENTAL MEANS	99.3	2.0	5.3	12.4	29.0	2.5	189.3	26.4	38.6	11.7	61.6	16.1
LSD (0.05)	0.8	0.0	0.9	3.4	5.9	0.9	1.1	1.6	5.6	0.3	0.6	0.7
C.V. 2: (S OF MEAN/MEAN)*100	0.3	0.0	5.5	9.2	7.0	12.2	0.2	2.0	4.9	0.9	0.3	1.4

1/ Row Style/Appearance: 1=solid band, 2= paired/joined bands, 3=paired/separate bands
2/ Average `splayed' stubble width 4" above soil surface at harvest maturity
3/ Average no.of fertile culms (stems with filled heads) per linear foot (ft2 on a 12-in. row spacing)
4/ No. of Days from January 1 (184 = July 3)
5/ Volumetric yields are based on 60 lbs/bu as the standard test weight for wheat.
6/ Protein values are adjusted to 12 percent grain moisture.

Site Resource & Management Data:										
Field	A-3-4		Planting Date	17-May		Cropping System	CT-MechFlw		Precip (in.) Plnt'g-Harvest	10.23
Quarter	NW		Planting Depth (in.)	1.5		Fertilizer Formulation	Gran.Blend		Precip (>.1) Plnt'g-Harvest	9.63
Section	33		Moist Soil Depth @Plnt'g	27		Fertilizer Placement	Bnd at Plntg		Herbicide App. Date	18-Jun
Tow nship	32N		Dry Surf Soil (in.) @Plnt'g	0.25		Fert. Rate (lbs/ac) N	70		Herbicide Product	Bronate
Range	15E		2" Soil Temp (oF) @ Plnt'g	54		Fert. Rate (lbs/ac) P2O5	40		Herbicide Rate (/ac)	24 oz
Soil Series	Scobey CL		4" Soil Temp (oF) @ Plnt'g	64		Fert. Rate (lbs/ac) K2O	25		Harvest Date	31-Aug

Table 2. [1]YIELD MEAN SUMMARY (Bu/Ac) FOR AIR DRILL OPENER INVESTIGATIONS CONDUCTED BY NORTHERN AGRICULTURAL RESEARCH CENTER - AGRONOMY (1997-2002)

(See Reports for Individual Investigations for Additional Performance Parameters, Site & Climatic Specifics, and Project Management Details)

	[2]NO-TILL RECROP SW-1997 (>BLY) HAVRE	CHEM+TILL FALLOW WW-1998 (>BLY) HAVRE	CHEM+TILL FALLOW SW-1998 (>BLY) HAVRE	[2]NO-TILL FALLOW WW-1998 (>WW) MOCCASIN	[2]NO-TILL RECROP WW-1998 (>SW) MOCCASIN	[2]NO-TILL RECROP WW-1998 [3](>BLY) MOCCASIN	NO-TILL FALLOW SW-1999 (>BLY) HAVRE	NO-TILL FALLOW SW-2000 (>WW) HAVRE	NO-TILL FALLOW SW-2001 (>SW) HAVRE	NO-TILL FALLOW SW-2002 (>WW) HAVRE
ANDERSON (Case-Concord) Triple Shooter		39.3	27.4	69.5	37.6	47.6	35.9	26.7	26.6	38.1
ATOM JET (HarvesTechnologies) Side Band								27.9	31.1	37.9
ATOM JET (HarvesTechnologies) 4" Paired Row										36.5
CONCORD LD w/Case-McKay 6" LD Sweep & K3 Knife		38.1		75.8	44.6	66.3				
CONCORD LD w/Case-McKay 11" LD Sweep & K3 Knife		35.3		69.6	40.9	63.7				
CONSERVA PAK System	22.4	36.7	27.2	73.5	43.9	80.0				
DUTCH SUPER EAGLE w/3.5" Paired Row Attachment							38.9	30.8	30.6	40.1
DUTCH SUPER EAGLE w/5.5" Paired Row Attachment							37.8	28.2	28.8	38.4
DUTCH S.E. w/FARMLAND Mid Row Fertilizer Banding Disk									27.2	36.8
FARMLAND LD w/Case-McKay 6" LD Sweep & K3 Knife			28.2				38.7	25.6	28.5	38.1
FARMLAND LD w/Case-McKay 11" LD Sweep & K3 Knife			25.9				38.6	23.6	26.4	40.4
FARMLAND SB1-SBS1 w/3" Knock-On Spoon & K3 Knife		35.4	21.2	70.6	37.1	46.6				
FARMLAND SB1-SBS1 w/4" Chrome Sweep & K3 Knife	19.5			75.1	47.6	64.2				
FARMLAND SB1-SBS1 w/4" Knock-On Sweep & K3 Knife		40.0	25.6	74.5	47.1	62.8	35.4	26.6	27.4	
FARMLAND SB1-SBS1 w/6" Knock-On Sweep & K3 Knife	23.9	41.0	24.0	70.3	48.1	58.9	35.7	28.1	27.4	38.8
FARMLAND SB1-SBS1 w/10" Knock-On Sweep & K3 Knife			23.5				35.2			
FLEXICOIL STEALTH w/Single Side Band Attachment	23.5	42.2	25.3	65.9	39.7	48.1	30.7			
FLEXICOIL STEALTH w/Paired Row Attachment	23.4	31.2	25.7	68.6	36.5	46.2	27.8	27.9	27.5	40.4
GEN T2	23.4									
GEN T2x2		41.1	26.3	71.9	45.7	58.5	37.0	27.1	28.1	38.9
MORRIS Gumbo Boot								24.3	27.8	
SWEDE	22.5	36.8		63.8	42.0	60.9		26.3		
SITE MEANS	22.4	37.9	25.5	71.0	42.4	58.6	35.6	26.9	28.1	38.6
LSD (.05)	2.8	5.3	3.7	7.9	7.7		4.4	2.9	4.9	5.6

[1]G.R. Carlson, Northern Agricultural Research Center, Havre - Moccasin trials conducted in cooperation with D.M. Wichman, Central Agricultural Research Center, Moccasin. All openers are "double-shoot" configurations with seeding rate at 60#/ac and fertilizer at 70#N, 40#P_2O_5, and 25#K_2O via blended granular fertilizer at 251#/ac.

[2]Trials conducted in conjunction with "Fields of Tomorrow" shows in 1997 and 1998.

[3]This trial had heavy volunteer barley pressure. Certain systems affording minimal soil disturbance produced higher wheat yields due to less competition with volunteer barley.

Table 3. Five-Year Yield Summary on Selected Entries from Dryland Fallow Evaluation of Double-Shoot Air Drill Openers with Spring Wheat. Northern Agricultural Research Center. Havre, Montana. 1998-2002.

(See Reports for Individual Investigations for Additional Performance Parameters, Site & Climatic Specifics, and Project Management Details)


	No. of YEARS TESTED	CHEM+TILL FALLOW SW-1998 (>BLY) HAVRE	NO-TILL FALLOW SW-1999 (>BLY) HAVRE	NO-TILL FALLOW SW-2000 (>WW) HAVRE	NO-TILL FALLOW SW-2001 (>SW) HAVRE	NO-TILL FALLOW SW-2002 (>WW) HAVRE	AVERAGE for YEARS TESTED	% of CHECK YIELD 1/	**5-YEAR COMP. AVERAGE YIELD 2/**
DUTCH SUPER EAGLE w/3.5" Paired Row Attachment	4		38.9	30.8	30.6	40.1	35.1	108.0	**33.3**
FARMLAND LD w/Case-McKay 6" LD Sweep & K3 Knife	5	28.2	38.7	25.6	28.5	38.1	31.8	103.3	**31.8**
ATOM JET (HarvesTechnologies) Side Band	3			27.9	31.1	37.9	32.3	102.8	**31.7**
DUTCH SUPER EAGLE w/5.5" Paired Row Attachment	4		37.8	28.2	28.8	38.4	33.3	102.5	**31.6**
GEN T2x2	5	26.3	37.0	27.1	28.1	38.9	31.5	102.2	**31.5**
FARMLAND LD w/Case-McKay 11" LD Sweep & K3 Knife	5	25.9	38.6	23.6	26.4	40.4	31.0	100.6	**31.0**
ANDERSON (Case-Concord) Triple Shooter	5	27.4	35.9	26.7	26.6	38.1	30.9	100.4	**30.9**
FARMLAND SB1-SBS1 w/6" Knock-On Sweep & K3 Knife	5	24.0	35.7	28.1	27.4	38.8	30.8	100.0	**30.8**
FARMLAND SB1-SBS1 w/4" Knock-On Sweep & K3 Knife	4	25.6	35.4	26.6	27.4		28.7	99.8	**30.7**
FLEXICOIL STEALTH w/Paired Row Attachment	5	25.7	27.8	27.9	27.5	40.4	29.9	96.9	**29.9**
ENTRY MEANS (For Entries Included in this Multi-Year Summary)		26.2	36.2	27.3	28.2	39.0			31.3
TRIAL MEANS (For All Entries Included in Original Single-Year Trial)		25.5	35.6	26.9	28.1	38.6			
LSD (.05) (For All Entries Included in Original Single-Year Trial)		3.7	4.4	2.9	4.9	5.6			

Check Entry is (FARMLAND SB1-SBS1 w/6" Knock-On Sweep & K3 Backswept Knife)

1/ Percent of check entry yield performance for the same data years as those in which a given entry was tested.

2/ 5-Yr Comparable Average Yield = (x/y)*z where x = average yield of a given entry for years tested, y = average yield for the Check Entry for the same years, and z = 5-Yr average yield for the Check Entry.

Figure 1. ANDERSON (Case-Concord) Triple Shooter, Post-Harvest, Seed Band Width = 4.8 Inches

Figure 2. ATOM JET (HarvesTechnologies) Side Band, Post-Harvest, Seed Band Width = 2.9 Inches

Figure 3. ATOM JET (HarvesTechnologies) 4” Paired Row, Post-Harvest, Seed Band Width = 5.5 Inches

Figure 4. DUTCH Super Eagle w/3.5” Paired Row Attachment, Post-Harvest, Seed Band = 4.7 Inches

Figure 5. DUTCH Super Eagle w/5.5” Paired Row Attachment, Post-Harvest, Seed Band = 7.2 Inches

Figure 6. DUTCH S.E. w/FARMLAND Mid-Row Banding Disk, Post-Harvest, Seed Band = 2.1 Inches

Figure 7. FARMLAND LD w/6” Case-McKay LD Sweep, Post-Harvest, Seed Band Width = 6.8 Inches

Figure 8. FARMLAND LD w/11” Case-McKay LD Sweep, Post-Harvest, Seed Band Width = 6.8 Inches

Figure 9. FARMLAND SB1-SBS1 w/6” Knock-On Sweep, Post-Harvest, Seed Band Width = 6.1 Inches

Figure 10. FLEXICOIL STEALTH w/Paired-Row Attachment, Post-Harvest, Seed Band Width = 4.6 Inches

Figure 11. GEN T2x2, Post-Harvest, Seed Band Width = 6.7 Inches

Figure 12. MORRIS Gumbo Boot, Post-Harvest, Seed Band Width = 4.2 Inches