PROJECT TITLE: Statewide evaluation of chickpea (Garbonzo bean) variety performance (Montana Uniform Chickpea Performance Trial)

EXPERIMENT NO.: #89

PROJECT LEADER: D.M. Wichman, Agronomist, CARC, Moccasin, MT
K.E. Neill, Research Associate, CARC, Moccasin, MT

PROJECT PERSONNEL: J. Eckhoff, Agronomist, EARC, Sidney, MT
J. Holmes, Research Associate, MSU, Bozeman, MT
G. Jackson, Agronomist, WTARC, Conrad, MT
K. Kephart, Agronomist, SARC, Huntley, MT
P. Lamb, Research Associate, SARC, Huntley, MT
J. Miller, Research Associate, WTARC, Conrad, MT
P. Miller, Associate Professor, MSU, Bozeman, MT
F.J. Muehlbauer, Geneticist, USDA-ARS, Pullman, WA
R.W. Short, Agronomist, USDA-ARS, Pullman, WA

OBJECTIVES:
To evaluate grain yield potential of chickpea varieties under dryland conditions across Montana.

METHODS:
The 2001 Montana Uniform Chickpea Performance Trial (UCPT) consisted of four desi-type and seven kauli-type chickpea entries, of which two were "small" kabuli-types. The trial was established at five dryland sites (Bozeman, Conrad, Huntley, Moccasin, and Sidney). A range in seed size and growth habit was observed in the entries (**Table 17**). The trial was seeded during the last week of April through the middle of May into both fallow and re-cropped stubble conditions and harvested at grain maturity during the middle and third weeks of August (Table 22). Other important production methods for each testing site are summarized in **Table 18**.

RESULTS:
Drought-like conditions persisted into the 2001 cropping year across much of Montana. Below normal growing season precipitation was recorded at all sites, with Sidney being the exception. The above normal precipitation that fell during June, followed by warm humid conditions, at the Sidney site accelerated an outbreak of *Ascochyta* blight causing severe damage to the chickpea trial. Low grain yields were reported at the Conrad site which received only 2.28 inches of precipitation between seeding date and end of July.

Chickpea Grain Yields: Statewide, dryland chickpea grain production averaged 1,258 pounds per acre (20.9 bu/acre) in 2001 (**Table 19)**. Desi- and small kabuli-type chickpeas performed the best averaging 1,522 pounds per acre with CDC Anna (desi) having the best statewide yield (1,697 lbs/acre), which was only significantly higher than the large kabuli-type chickpeas. The large kabuli-types had lower yields, averaging 941 pounds per acre (15.7 bu/acre) with CDC Xena performing the best (1,036 lbs/acre). The Bozeman site had the highest trial average yield with 1,761 pounds per acre. At this site, the large kabuli-types appeared to perform better than the desi-types. The desi- and small kabuli-type chickpeas performed the best at the Sidney site. This site provided valuable insight into disease resistance qualities of the chickpea varieties entered. *Ascochyta* blight set in early in plant development (June) and was observed in all entries. The large kabuli-type chickpeas appeared to have the least resistance to the disease as indicated by significantly lower yields compared with desi- and small kabuli-type chickpeas. Of the large kabuli-types evaluated, CDC Yuma appeared to have the most resistance to *Ascochyta* having a grain yield of nearly 850 lbs/acre, while the remaining kabuli-types averaged only 90 lbs/acre. Chickpea yields at Conrad were severely impacted by the drought-like conditions experienced there.

Kernel Weights: At three selected sites, one thousand kernel weights varied from each other (**Table 20**). However, CDC Xena had the largest seed size at each location (significant at Moccasin and Huntley) with an average of 426.8 grams per 1,000 kernels. Thousand kernel weights at Moccasin were highest, averaging 370.2 grams per 1,000 kernels. At the Moccasin site, grain sizes (for marketing purposes) were

evaluated. Grain samples were passed over 10mm, 9mm, 8mm, and 7mm sieves. In general, kabuli-type varieties were large enough to fit into the market (some market losses could occur due to seed discoloration). CDC Xena had the highest percentage of kernels greater than eight millimeters (unreplicated). Test weights averaged 59.3 pounds per bushel for the Sidney, Moccasin and Huntley sites, with Huntley having the highest test weights (62.3 lbs/bu). The severe outbreak of *Ascochyta* blight at the Sidney site, resulted in insufficient seed of four of the kabuli-type chickpeas for measuring test weights.

Plant Heights: There were no differences in canopy height among chickpeas cultivars over the three sites where height data was collected (**Table 21**). CDC Yuma kabuli-type chickpea appeared to be the tallest chickpea at grain maturity (16.8 inches). Sidney reported the tallest canopy heights of the three testing sites. The kabuli-type chickpeas at the Huntley site appeared to be taller than the desi-type chickpeas.

Flowering: The desi-type chickpeas CDC Nika, CDC Chico, CDC Desiray and Myles were the earliest varieties to flower (**Table 22**). Overall, desi-type chickpeas appeared to flower earlier than the kabuli-type at all locations. Flowering occurred between seven and 12 days earlier at the Huntley site than all the other locations.

UCPT Multi-year (1998-2001) Summary: By summarizing four years (1998-2001) of performance trials, statewide, Dwelley (kabuli-type) chickpea was out yielded by all other varieties of chickpeas evaluated, except for the one-year trial at Bozeman (**Table 23**).

FUTURE RESEARCH:
Evaluating chickpea varieties for yield performance across Montana will continue.

Table 17. 2001 Statewide Uniform Chickpea Performance Trial - Chickpea grain yield summary. - Exp. 890001. Central Agricultural Research Center, Moccasin, MT. **{File: 890001-Character}**

Variety	Seed Source	Type	Seed Size[1/]	Leaf Structure[2/]	*Ascochyta* Tolerance	Maturity
Myles	CARC	Desi	Very Small	Fern-like	Fair	Early
CDC Anna	CDC - U of Sask.	Desi	Very Small	Fern-like	Fair	Early
CDC Desiray	CDC - U of Sask.	Desi	Very Small	Fern-like	Fair	Early
CDC Nika	CDC - U of Sask.	Desi	Small	Fern-like	Fair	Early
CDC Chico	CDC - U of Sask.	Small Kabuli	Small	Fern-like	Poor	Early
Sanford	USDA-ARS	Kabuli	Large	Unifoliate	Very Poor	Late
CDC Yuma	CDC - U of Sask.	Kabuli	Large	Fern-like	Poor	Late
Evans	USDA-ARS	Kabuli	Large	Unifoliate	Very Poor	Late
Dwelley	CARC	Kabuli	Very Large	Unifoliate	Very Poor	Very Late
CDC Xena	CDC - U of Sask.	Kabuli	Very Large	Unifoliate	Very Poor	Medium
Sierra	USDA-ARS	Kabuli	Very Large	Unifoliate	Very Poor?	Medium

[1/] - Seed Size class ranges (g/1,000 seeds): Very Small: 175 - 250 Small: 250 - 350 Large: 375 - 475 Very Large: 475+

[2/] - "Fern-like" indicates a pinnately compound leaf structure

Table 18. 2001 Montana Uniform Chickpea Performance Trial - Testing site trial production summary. - Exp. 890001. Central Agricultural Research Center, Moccasin, MT. **{File: 890001-SiteInfo}**

Testing Site:	Sidney	Moccasin	Huntley	Conrad	Bozeman
Field Summary					
Environment:	Dryland	Dryland	Dryland	Dryland	Dryland
Tillage History:	Conventional	Conventional	Conventional	Conventional	No-Till
Previous Crop:	Fallow	Fallow	Fallow	Barley	Barley
Trial Management					
Seeding Date:	5/03	5/08	4/20	4/26	4/30
Harvest Date:	8/09 - 8/23	8/17	8/14	8/15	8/28
Timing: [1/]	Maturity	All	All	All	All
Fertilizer: (lbs/ac)	None	None	18-46-0 (100)	11-52-0 + potash (58)	0-18-31-11(100)
Method: [2/]			Pr-P Incorp	Top-dress @ seeding	W/ seed
Pesticides:(rates)	Hand Weed	Hand Weed	Prowl (2pt/ac) RoundUp (1pt/ac)	None	Sonalan (8lbs/a) RoundUp (12/oz) Assure (8/0z)
Method: [2/]			Pr-E		Pr-P Incorp (4/5/02) Pr-E (5/2/02) Po-E (6/11/02)
Precipitation: [3/]	16.43"	7.34"	7.95"	2.28"	6.72"
Elevation:	2200'	4300'	2990'	3700'	4780'

[1/] - Harvest was conducted at variety maturity ("Maturity"), or all varieties at same time ("All")
[2/] - Pr-P = Pre-Plant; Pr-E = Pre-Emergence; Po-E = Post-Emergence; Incorp = Incorporated
[3/] - Precipitation from seeding to grain maturity (Apr-Aug - Sidney)

Table 19. 2001 Statewide Uniform Chickpea Performance Trial - Chickpea grain yield summary. - Exp. 890001. Central Agricultural Research Center, Moccasin, MT. **{File: 890001-Yield}**

	Grain Yield (lbs/acre)					
Variety	Sidney[1/]	Mocc.	Huntley	Conrad	Boze.	Ave
CDC Anna	2,370 [a]	1,500 [a]	**1,839 [a]**	**905 [a]**	1,873 [a]	**1,697 [a]**
Myles	2,367 [a]	1,417 [a]	1,838 [a]	854 [a]	1,595	1,614 [a]
CDC Desiray	**2,699 [a]**	**1,520 [a]**	1,549	709 [a]	1,553	1,606 [a]
Amit	2,148	1,026	1,487	857 [a]	**1,963 [a]**	1,496 [a]
CDC Chico	1,655	1,368 [a]	1,711 [a]	763 [a]	1,718 [a]	1,443 [a]
CDC Nika	1,261	1,364 [a]	1,448	739 [a]	1,576	1,278 [a]
CDC Xena	180	1,149	1,306	653	1,894 [a]	1,036
CDC Yuma	849	742	1,054	609	1,894 [a]	1,030
Sanford	55	784	1,235	712 [a]	1,820 [a]	921
Evans	78	898	1,153	642	1,681	890
Dwelley	46	677	1,037	570	1,805 [a]	827
CA9783153C	-----	777	876	-----	-----	(827) [2/]
CA9783165C	-----	128	889	-----	-----	(509) [2/]
Site Means	1,482	1,027	1,340	728	1,761	1,258
$LSD_{0.05}$	459	330	221	203	246	571
CV%	25.5	22.4	11.5	19.3	9.7	35.5

[ns] - Indicates no statistical significance at 0.10 level.
[1/] - Severe *Ascochyta* blight disease pressures occurred at Sidney; significantly impacting kabuli yields.
[2/] - Average for two locations, not included in Statewide average.

Table 20. 2001 Montana Statewide Chickpea Performance Trial - Chickpea seed size and weight summary.
- Exp. 890001. Central Agricultural Research Center, Moccasin, MT. **{File: 890001- SeedWts}**

	Kernel Size				Test Weights			
Selection	Moccasin	Huntley	Bozeman	Ave.	Sidney	Moccasin	Huntley	Ave.
	(% >8 mm)[1/]	(g / 1,000 seeds)			(lbs / bushel)			
CDC Xena	**97.9**	**505.5** [a]	**381.0** [a]	**394.0** [a]	**426.8** [a]	xx[2/]	57.4	63.2	59.45
Evans	89.7	441.8	335.3	376.8	384.6	xx[2/]	58.0	62.6	59.45
Dwelley	90.0	430.0	330.0	381.8 [a]	380.6	xx[2/]	57.5	62.6	59.20
Sanford	93.9	440.8	330.0	368.3	379.7	xx[2/]	57.7	63.1	59.55
CDC Yuma	75.9	413.0	318.8	361.5	364.4	53.8	58.2	62.6	58.20
Amit	84.7 [3/]	294.0	194.0	225.5	237.8	**61.1** [a]	60.1 [a]	**64.8** [a]	**62.00** [a]
CDC Chico	84.0 [3/]	277.8	196.0	216.0	229.9	59.2	59.2	63.7 [a]	60.70 [a]
CDC Nika	99.0 [3/]	369.3	276.8	266.2	304.1	56.8	57.9	61.2	58.63
CDC Anna	50.5 [3/]	240.3	159.5	178.3	192.7	59.8 [a]	**61.0** [a]	63.6 [a]	61.47 [a]
CDC Desiray	42.3 [3/]	230.5	166.0	171.8	189.4	59.2	60.3 [a]	61.2	60.23 [a]
Myles	72.9 [3/]	231.9	164.3	173.3	189.8	57.5	57.2	59.6	58.10
CA9783153C	93.2	471.8	357.3	----[4/]	407.0 [a]	----[4/]	57.6	61.9	58.90
CA9783165C	93.8	456.7	362.8	----[4/]	402.2	----[4/]	50.9	59.7	54.45
Site Means		370.2	274.7	283.0	314.6	58.2	57.9	62.3	59.26
LSD (0.05 by t)		21.4	13.4	15.9	22.5	1.8	1.0	1.1	2.44
C.V.% (s/means)		4.03	3.39	3.08	4.22	3.3	1.17	1.26	2.40

[a] - Denotes values equal to highest value (in **bold**) based on $LSD_{(0.05)}$.
[1/] - Percentage of seed remaining on 8mm (20.5/64") round sieve.
[2/] - Insufficient seed supply due to severe *Ascochyta* blight infestation.
[3/] - Small kabuli- and desi-type chickpeas; percentage of seed remaining on 7mm (18/64") round sieve.
[4/] - Selections not evaluated at Bozeman or Sidney sites.

Table 21. 2001 Montana Statewide Chickpea Performance - Chickpea maturity plant height summary.
- Exp. 890001. Central Agricultural Research Center, Moccasin, MT. **{File: 890001- PlantHt}**

Cultivar	**Sidney**	**Moccasin**	**Huntely**	**Average**
CDC Anna	16.5	15.0 [a]	13.5	15.0 [ab]
Myles	16.5	14.8 [a]	13.5	14.9 [ab]
CDC Desiray	16.5	13.5	11.5	13.8 [b]
Amit	19.3	14.3 [a]	15.5	16.4 [a]
CDC Chico	18.9	14.5 [a]	16.0 [a]	16.5 [a]
CDC Nika	18.9	14.3 [a]	15.2	16.1 [ab]
CDC Xena	17.3	**15.5** [a]	13.7	15.5 [ab]
CDC Yuma	**19.7** [ns]	13.3	**17.4** [a]	**16.8** [a]
Sanford	15.7	15.0 [a]	17.1 [a]	15.9 [ab]
Evans	16.5	13.5	**17.4** [a]	15.8 [ab]
Dwelley	16.9	13.0	17.3 [a]	15.7 [ab]
CA9783153C [1/]	---	13.8 [a]	16.0 [a]	15.8 [ab]
CA9783165C [1/]	---	13.8 [a]	15.6 [a]	15.6 [ab]
	17.6	14.15	15.4	15.68
	ns	1.8	2.0	2.45
	13.3	8.875	8.87	9.237
	[ns]	1.49 [ns]	7.38 [**]	0.84 [ns]

[ns] - Indicates no statistical significance at 0.10 level.
** - Indicates statistical significance at 0.05 level.
[a,ab,etc.] - Values with same letters not different based on $LSD_{(0.05)}$; **Bold** values tallest entries at site.
[1/] - Selections not evaluated at Sidney site.

Table 22. 2001 Montana Statewide Chickpea Performance Trial - Chickpea flower date summary.
- Exp. 890001. Central Agricultural Research Center, Moccasin, Montana. **{File: 890001- Dates}**

Selection	Sidney	Moccasin	Huntley	Conrad	Bozeman	Average
	(days from seeding)					
CDC Desiray	**54** [a]	47	39	63 [a]	55	52 [a]
CDC Anna	56 [a]	49	41	66 [a]	57	54 [b]
Myles	55 [a]	48	39	64 [a]	55	52 [a]
CDC Chico	**54** [a]	46	**38** [a]	**63** [a]	53	51 [a]
Amit	63	50	46	67	60	57 [ed]
CDC Nika	56 [a]	**44** [a]	**38** [a]	**63** [a]	**52** [a]	**51** [a]
Sanford	60	54	48	68	61	58 [fe]
CDC Yuma	61	52	41	67	59	56 [c d]
Evans	60	49	44	66 [a]	57	55 [cb]
Dwelley	61	54	49	68	60	58 [fe]
CDC Xena	58	51	42	64 [a]	57	54 [cb]
CA9783153C [1/]	---	53	49	---	---	60 [f g]
CA9783165C [1/]	---	55	49	---	---	61 [g]
Site Means	58	50	43	65	57	55
LSD (0.05 by t)	2	1	1	4	1	2
C.V. % (s/means)	2.4	1.79	0.45	4.04	0.273	2.54
F-Value for Selec.	<0.001	56.35 **	143.8 **	2.52 **	64.13 **	28.61 **

** - Statistically significant at 0.05 level.
[a,ab,etc.] - Values having same letter not different at 0.05 level (based on LSD); **Bold** - earliest varieties at site.
[1/] - Selections not evaluated at Sidney, Conrad or Bozeman - "Average" dates calculated during analysis.

Table 23. 2001 Chickpea - Multi-year ('98-'01) summary; A-variety/Dwelley comparative; B-grain yields. - Exp. 890001. Central Agricultural Research Center, Moccasin, MT. **{File: 890001-MYSum}**

A:

Variety	Sidney [1/]	Moccasin	Huntley	Conrad	Bozeman	Average [2/]
	2	3	3	2	1	11
	(% of Dwelley Yield)					
Dwelley	**100**	**100**	**100**	**100**	**100**	**100**
CDC Chico	----	388	169	144	95	225
Myles	171	367	176	174	88	223
CDC Xena	----	326	142	125	105	194
CDC Yuma	----	210	109	170	105	143
Sanford	113	129	127	134	101	125
Evans	91	143	116	120	93	120
Mean (*n*)	$119_{(4)}$	$238_{(21)}$	$134_{(21)}$	$131_{(14)}$	$98_{(7)}$	$161_{(70)}$
$LSD_{0.05\ by\ t}$	-----	ns	29	ns	-----	88
C.V.% (s/mean)	-----	69.4	11.76	10.82	-----	61.2
F-Value (df=6)	-----	1.61 [ns]	10.50 [**]	5.54 [ns]	-----	2.75 [**]

B: Average Chickpea Grain Yields

	(lbs / acre)[3/]					
Dwelley	$565_{(2)}$	$272_{(3)}$	$1,157_{(3)}$	$406_{(2)}$	$1,805_{(1)}$	$799_{(11)}$
Myles	**$2,112_{(2)}$**	**$722_{(3)}$**	$1,932_{(3)}$	**$667_{(2)}$**	$1,595_{(1)}$	**$1,275_{(11)}$**
CDC Chico[4/]	$1,980_{(1)}$	$717_{(2)}$	**$1,970_{(2)}$**	$588_{(1)}$	$1,718_{(1)}$	$1,249_{(7)}$
CDC Xena[4/]	$506_{(1)}$	$584_{(2)}$	$1,654_{(2)}$	$478_{(1)}$	**$1,894_{(1)}$**	$1,110_{(7)}$
Sanford	$641_{(2)}$	$320_{(3)}$	$1,436_{(3)}$	$530_{(2)}$	$1,820_{(1)}$	$938_{(11)}$
CDC Yuma[4/]	$1,174_{(1)}$	$338_{(2)}$	$1,179_{(2)}$	$434_{(1)}$	**$1,894_{(1)}$**	$863_{(7)}$
Evans	$531_{(2)}$	$362_{(3)}$	$1,261_{(3)}$	$476_{(2)}$	$1,681_{(1)}$	$849_{(11)}$
Means[6/] (*n*)	$1,073_{(14)}$	$474_{(21)}$	$1,513_{(21)}$	$512_{(14)}$	$1,772_{(7)}$[5/]	$1,012_{(70)}$
$LSD_{0.05\ by\ t}$	ns	321	293	52	-----	ns
C.V.% (s/mean)	51.6	36.7	10.50	3.2	-----	65.0
F-Value (df=6)	3.85 [ns]	3.77 [**]	14.10 [**]	62.84 [**]	-----	0.91 [ns]

[1/] - Comparative analysis not replicated; 1998 data only – 2001 not included due to *Ascochyta* damage
[2/] - Multi-year average does not include Sidney 2001 grain yields, due to severe *Ascochyta* damage
[3/] - Numbers in parenthesis indicate number of site-years varieties tested at each location
[4/] - CDC Chico, CDC Xena and CDC Yuma site means for one (1) site-year are statistical estimates
[5/] - Bozeman averages for one year (2001) only
[6/] - Site means account for missing values (statistical estimates)