

Regional Adaptation Studies with Dry Bean

A.Vandenberg and A.E. Slinkard

Crop Development Centre, 5 1 Campus Drive, University of Saskatchewan
Saskatoon, Saskatchewan S7N 5A8

The potential for development of the dry bean sector of Saskatchewan's pulse industry has been limited by lack of adapted varieties. The Crop Development Centre (CDC) has been actively engaged in breeding pinto beans and other market classes for the past several years. Adapted breeding lines from the CDC and the Agriculture and Agri-Food Canada breeding program at Lethbridge are at the stage of recommendation for registration. The next logical step in the development process is regional testing of new varieties. In 1995, dry bean regional trials were grown for the first time in Saskatchewan with financial assistance from the Saskatchewan Pulse Crop Development Board and the Canada-Saskatchewan Agricultural Green Plan - Innovative Partners Program. The project was designed (1) to sample the dry bean production potential of targeted environments within Saskatchewan using current and newly released varieties, and (2) to give extension personnel, pulse growers and researchers across Saskatchewan an opportunity to become familiar with this new pulse crop. The 1995 results were published in Saskatchewan Agriculture and Foods annual publication "Varieties of Grain Crops 1996". Data are included in that publication on the basis of a statistical test of variability which means that all sites may not be included. This report covers a more detailed perspective of the results of those trials in the context of adaptation to various potential dry bean production environments in Saskatchewan.

An analysis of all 15 test sites shows that pinto bean yields were very low in Area 1, which corresponds generally to the Brown Soil zone in Saskatchewan (Table 1). We have grown a nursery in the Elrose area for several years now with poor results. We explained this in part by suggesting that environment factors, mainly drought, caused a yield limitation. In 1995, however, all Brown Soil sites received adequate rainfall. Based on visual symptoms alone, we now suspect that soil factors may play a role in poor performance. As expected, under irrigation, yields are reasonably stable as shown by the small range between the highest and lowest yielding sites. For the Dark Brown, Thin Black Soil and Black Soil zones, actual mean yields were roughly half of irrigated yields. The range of yields show that in areas that receive above average rainfall, dryland yields approach the yield of irrigated sites. The very low yielding sites were generally poorer yielding due to a combination of weather factors (frost) or management factors (late seeding, poor weed control, poor stands). If the high yielding sites alone are considered, the yield range as measured on a plot basis is in the same range as the yields we record for lentil yield plots. This implies that the potential commercial yield of pinto bean in Saskatchewan is similar to the potential commercial yield of lentil, at least in the most favourable environments.

The yield of black bean varieties in Saskatchewan in 1995 was lower than yield of pinto bean varieties (Table 1). The only possible exception to this was the Dark Brown soil zone. This corresponds reasonably well with our own longer term experience which

shows that, as a group, black beans are usually lower than pintos at least when the current set of varieties are compared. Irrigation yields were stable but low relative to the pinto class. Performance in the Brown Soil zone was similar (poor). In all other soil zones, the high end of the yield range on dryland sites was reasonably close to the mean yield recorded under irrigation. Most sites were direct harvested by small plot combines, so this may be an indication that canopy structure is less of a yield limitation for black beans which typically have pods held higher in the canopy than the pinto bean varieties in this set of trials.

Canopy structure is a major consideration in our efforts to develop improved varieties of dry bean for Saskatchewan. Over the past several years, a simple rating system based on pod clearance above the cutterbar was developed for use in the breeding program. Prior to direct harvest with a small plot combine, a percentage visual estimate is made of the percentage of pods in the plot canopy that will clear an assumed cutterbar height of about 4 cm above ground level. The difference between the pinto and black market classes with respect to canopy structure is clear (Table 2). Mean pod clearance scores for black bean varieties was greater than for pintos, and also less variable, as indicated by the range values. When a pod clearance index (PCI) value is calculated by subtracting the range value from the mean for 7 sites, the pinto varieties Othello and Fargo show negative index values. The three highest index values were CDC Espresso, CDC Nighthawk and CDC Whistler. These three varieties were released in the past two years.. Indirectly, this shows that good progress is underway in selecting for better canopy structure.

When PCI values are calculated from data taken from the six available sites for the 1994 and 1995 Prairie Bean Coop Trials - Narrow Rows, a similar pattern emerges (Table 2). The PCI value for Othello matches that observed in the 1995 regional trials, but several pinto breeding lines have PCI values closer to the range observed for black and navy beans. Pinto line 92121 was recommended for registration in February 1995 on the basis of its high yield performance, which may in fact mean that it loses less yield under direct harvest conditions. This is the first Saskatchewan-bred pinto bean variety. It will be included in the 1996 Saskatchewan Bean Regional Trials.

The 1995 data for days to flowering and maturity show that great variation exists among varieties within market classes. but that even greater variation exists among environments (Table 3). Overall, the relative order of varieties with respect to days to flowering was almost the same as the relative order for days to maturity. A similar pattern was observed for the range in both of these characteristics.

Finally, the analysis of seed weight shows that this is a very variable characteristic from one environment to the next (Table 3). In general, the relative ranking of seed weight from variety to variety does not change, but seed weight may almost double from environment to the next as a direct result of differences in moisture availability during filling, date of first frost, onset of stem diseases like Sclerotinia, or other environmental factors. The range of seed weight within varieties but among environments is more similar to that observed in field pea crops than lentil crops.

Table 1. Analysis of yield of pinto and black bean varieties by production area and soil zone in the Saskatchewan Bean Regional Trial in 1995

Variety/market class	Soil Type class	Area 2	Area 1	Area 2	South	North
		Irrigated	Dryland	Dryland	Area 3 Dryland	Area 3 Dryland
			Brown	Dark Brown	Thin Black	Black
		4 sites	2 sites	3 sites	2 sites	4 sites
-----Yield relative to Othello pinto-----						
Othello pinto		100	100	100	100	100
Fargo pinto		100	98	74	90	107
	<i>Mean yield (kg/ha)</i>	3 720	1039	1867	2201	1725
	<i>Lowest mean yield (kg/ha)</i>	3254	586	1320	992	678
	<i>Highest mean yield (kg/ha)</i>	3958	1493	2330	3411	3312
UI 906 black		65	97	116	70	54
CDC Espresso black		51	82	91	76	78
CDC Nighthawk black		57	66	75	72	52
	<i>Mean yield (kg/ha)</i>	2143	859	1839	1690	1658
	<i>Lowest mean yield (kg/ha)</i>	2038	211	1531	977	271
	<i>Highest mean yield (kg/ha)</i>	2287	1492	2125	2403	2085

Table 2. Mean, minimum and maximum scores, range and index of percent pod clearance for selected bean varieties or breeding lines grown in the Saskatchewan Regional Trial 1995, and the Prairie Bean Cooperative Trial - Narrow Rows, 1994-95

Trial and number of locations	Market class	Variety	Percent pod clearance				Pod clearance index*
			Mean	Minimum score	Maximum score	Range	
1995 Regional 7 locations in Saskatchewan	Pinto	Othello	43	10	80	70	-27
	Pinto	Fargo	53	25	81	56	-3
	Black	UI 906	74	49	94	45	29
	Black	CDC Espresso	87	80	96	16	71
	Black	CDC Nighthawk	76	60	93	33	43
	Sm.white	CDC Whistler	59	65	91	26	33
	Navy	OAC Seaforth	65	20	75	55	10
	Navy	AC Skipper	78	25	93	68	10
1994-95 Narrow Narrow Row Coop 6 locations in W. Canada	Pinto	Othello	40	11	73	62	-22
	Pinto	92121	64	40	79	39	25
	Pinto	9202 1	54	10	80	70	-16
	Pinto	92144	65	50	85	35	30
	Pinto	92235	57	30	74	44	13
	Pinto	92802	54	26	73	47	7
	Black	UI 906	77	60	89	29	48

* Pod clearance index is range subtracted from mean

Table 3. Mean and range in days to flower, maturity and seed weight for 8 dry bean varieties grown in the Saskatchewan Dry Bean Regional Trial in 1995

Market class	Variety	Days to flower		Days to maturity		Seed weight (mg)	
		Mean (8 locations)	Range	Mean (8 locations)	Range	Mean (14 locations)	Range
Pinto	Othello	53	42-56	102	94-112	348	273-391
Pinto	Fargo	51	39-56	101	94-105	365	324-415
Black	UI906	59	50-65	108	101-111	152	112-174
Black	CDC Espresso	48	39-53	100	94-105	195	154-222
Black	CDC Nighthawk	58	48-63	106	101-111	166	114-192
Small white	CDC Whistler	60	51-66	112	105-119	156	95-187
Navy	OAC Seaforth	58	48-63	108	102-115	187	129-217
Navy	AC Skipper	56	46-62	108	101-111	202	131-256

In summary, 1995 Bean Regional Trials represented a useful starting point for assessment of both variety performance and regional adaptation of an important new pulse crop in Saskatchewan. This project was possible only through the close collaboration of Saskatchewan Agriculture and Food extension personnel, Agriculture and Agri-Food Canada researchers, the Saskatchewan Pulse Crop Development Board and the Crop Development Centre.