

Grain yield, stability and bacterial brown spot disease of dark red kidney dry bean (*Phaseolus vulgaris* L.) genotypes across six environments in South Africa

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Supplementary tables

Table S1. Genetic material used in this study

No	Line ID	Seed colour	100 seed weight (g)	Growth habit	Source	Original cross type/Origin
1	G01	Red	56.40	Type II	ARC-GCI-BP	M x M
2	G02	Red	61.13	Type II	ARC-GCI-BP	M x M
3	G03	Red	55.83	Type II	ARC-GCI-BP	M x M
4	G04	Red	63.37	Type II	ARC-GCI-BP	M x M
5	G05	Red	50.83	Type II	ARC-GCI-BP	M x M
6	G06	Red	62.70	Type II	ARC-GCI-BP	M x M
7	G07	Red	53.63	Type II	ARC-GCI-BP	M x M
8	G08	Red	52.67	Type II	ARC-GCI-BP	M x M
9	G09	Red	51.57	Type II	ARC-GCI-BP	M x M
10	G10	Red	55.27	Type II	ARC-GCI-BP	M x M
11	G11	Red	68.57	Type II	ARC-GCI-BP	M x M
12	G12	Red	72.30	Type II	ARC-GCIP-BP	M x M
13	G13 (Montcalm)	Red	69.60	Type II	ARC-GCIGC	USA
14	G14 (AC Calmont)	Red	55.40	Type II	ARC-GCIGC	USA

Source: Agricultural Research Council-GCIP (2018), ARC-GCI-BP= Agricultural Research Council-Grain Crops Institute Breeding Program and ARC-GCIP= Agricultural Research Council-Grain Crops Institute Germplasm Collection, M=Mesoamerican and USA=United State of America

Table S2. Geographic location and the weather data for six evaluation environments

	Potchefstroom		Warden		Clarens		Cedara		Middelburg		Carolina	
	Temp	Rain	Temp	Rain	Temp	Rain	Temp	Rain	Temp	Rain	Temp	Rain
Oct-17	26.39	56.13	24.89	49.53	23.40	59.00	22.70	145.00	24.90	28.45	24.10	4.00
Nov-17	29.12	69.34	27.05	82.04	25.30	46.00	24.10	136.00	29.30	19.56	25.50	54.00
Dec-17	29.29	62.48	26.06	208.79	25.70	117.00	23.50	98.00	32.01	10.03	25.10	155.00
Jan-18	31.04	47.24	28.39	111.49	27.40	114.00	27.10	65.00	32.74	111.51	26.50	89.00
Feb-18	27.68	68.33	26.75	69.80	25.40	53.00	26.50	228.00	30.68	77.47	25.80	79.00
Mar-18	27.54	58.93	23.63	131.52	23.30	146.00	25.70	156.00	29.21	22.10	24.80	119.00
Apr-18	25.33	35.56	22.90	12.95	22.10	18.00	25.30	65.00	24.75	62.74	23.60	9.00
May-18	22.78	11.18	20.32	25.65	29.10	26.00	21.50	38.00	21.61	14.48	20.10	23.00
Average	27.40	-	25.00	-	25.20	-	24.60	-	28.15	-	24.40	-
Total	-	409.29	-	687.77	-	579.00	-	931.00	-	346.34	-	532.00
Latitude		26.74		28.31		28.5		29.54		31.47		27.95
Longitude		27.08		29.11		28.58		30.26		25.03		29.43
Altitude		1349		1720		1849		1068		1277		1782

Source: Agricultural Research Council (2018). Temp =Temperature (°C); Rain = The rainfall (mm); Latitude=Latitude (°); Longitude =Longitude (°) and Altitude= meters above the sea level(m).

Table S3. Analysis of variance for grain yield and BBS severity of dark red kidney dry bean across six environments

Source	Grain yield (t ha ⁻¹)			BBS severity	
	DF	SS	MS	SS	MS
Environment	5	102.38	20.48***	2082.94	416.59***
Env. Rep	12	2.20	0.18**	691.67	57.64
Env. Rep. Block	18	2.90	0.16**	3660.71	203.37**
Genotype	13	8.43	0.65***	32164.91	2474.22***
GEI	65	23.70	0.37***	4462.06	68.65**
Residual	138	10.32	0.08	5794.46	41.99
Total	251	149.93	0.6	48856.75	194.65
LSD 5%			0.44		10.45
CV			19.11		19.32
Mean			1.43		33.53
SE			0.22		5.29

* P < 0.05, ** P < 0.01, *** P < 0.001, DF = Degrees of freedom, CV = Coefficient of variation, SS = Sum of squares, MS = Mean of squares, BBS=Bacterial brown spot, GEI=Genotype by environment interaction, LSD=Least significance difference, Grain yield=Grain yield (t ha⁻¹) and SE=Standard error of difference between predicted means, Env=Environment, Rep=Replication.

Table S4. Mean grain yield and BBS severity across six environments

Genotypes	Potchefstroom		Warden		Clarens		Cedara		Middelburg		Carolina		Mean Across Environments	
	Yield	BBS Severity	Yield	BBS Severity	Yield	BBS severity	Yield	BBS Severity	Yield	BBS severity	Yield	BBS severity	Yield	BBS severity
G01	2.79	48.33	1.50	60.00	1.31	48.33	1.13	45.00	0.87	60.00	0.64	40.00	1.37	46.39
G02	2.83	21.67	1.05	20.00	1.12	21.67	1.28	28.33	1.79	18.33	1.27	23.33	1.56	22.22
G03	3.02	18.33	1.25	33.33	1.24	25.00	1.00	23.33	2.02	25.00	1.21	23.33	1.62	24.72
G04	2.67	21.67	1.26	28.33	1.69	25.00	1.15	21.67	1.05	25.00	0.88	26.67	1.45	24.72
G05	2.81	28.33	1.20	20.00	1.09	28.33	1.16	20.00	1.53	21.67	1.11	25.00	1.48	23.89
G06	2.74	21.67	1.57	25.00	1.23	18.33	1.30	23.33	2.01	21.67	1.34	30.00	1.70	23.33
G07	3.41	25.00	1.44	28.33	1.06	31.67	0.10	33.33	0.68	35.00	0.53	26.67	1.35	30.00
G08	3.02	21.67	1.34	20.00	1.42	18.33	1.20	25.00	1.20	25.00	2.42	20.00	1.77	21.67
G09	2.40	25.00	1.02	28.33	0.84	26.67	0.94	28.33	0.51	31.67	1.10	25.00	1.13	27.50
G10	3.24	35.00	1.42	51.67	0.55	33.33	0.38	41.67	0.47	53.33	0.43	26.67	1.08	35.56
G11	2.91	41.67	1.05	60.00	1.18	40.00	1.23	43.33	0.53	56.67	0.76	38.33	1.28	39.44
G12	2.48	25.00	1.30	36.67	1.26	20.00	1.25	25.00	1.30	31.67	1.15	35.00	1.46	28.89
G13	2.96	51.67	1.07	53.33	0.94	51.67	1.41	48.33	0.70	58.33	1.04	50.00	1.35	48.89
G14	2.53	45.00	1.68	60.00	2.09	46.67	0.94	55.00	0.67	61.67	0.67	53.33	1.43	49.44
Mean	2.84	30.72	1.30	37.50	1.22	31.07	1.03	32.98	1.10	37.50	1.04	31.67	1.43	31.90

Yield=Grain yield (t ha^{-1}), BBS Severity=Bacterial brown spot severity (%), G01-G14=Genotypes

Table S5. Grain yield stability coefficients and genotypes ranking over six environments

Gen	EC1	R1	EC2	R2	EC3	R3	EC4	R4	EC5	R5	EC6	R6
G01	0.47	9	0.58	7	0.25	3	7.50	7	4.07	8	11.50	7
G10	0.82	14	12.67	14	11.56	12	3.00	13	5.80	13	30.30	14
G11	0.54	11	0.71	12	0.34	6	9.00	12	4.00	7	10.40	5
G12	0.32	6	0.26	1	0.20	1	6.50	5	3.40	4.5	11.10	6
G13	0.46	8	0.67	11	0.36	7	7.67	9	4.93	11	16.67	11
G14	0.49	10	0.62	10	13.53	14	8.00	10	5.87	14	29.60	13
G02	0.26	4	0.46	6	0.54	8	6.17	4	4.47	10	14.57	10
G03	0.22	3	0.59	9	0.71	10	5.58	3	4.23	9	11.84	8
G04	0.35	7	0.43	4	0.29	5	7.50	7	3.40	4.5	9.10	4
G05	0.30	5	0.45	5	0.21	2	7.50	7	2.87	3	5.50	2
G06	0.20	2	0.34	2	0.63	9	4.17	1	3.67	6	12.17	9
G07	0.55	12	11.18	13	0.77	11	8.33	11	5.47	12	22.27	12
G08	0.12	1	0.59	8	13.22	13	4.25	2	2.43	1	4.38	1
G09	0.61	13	0.43	3	0.26	4	12.33	14	2.53	2	7.07	3

Gen=Genotypes, R1-R6=Ranking one to six, EC1=Cultivar superiority, EC2=Static stability, EC3=Wricke's Ecovalence, EC4=Mean Ranks, EC5=Differences of pairs ranks and EC6=Variances of ranks.