APPENDIX A

Contents: Field data for DM, grain yield

Table 1A Effect of various herbicides on grain yield (g per plant) of ten dry bean cultivars

	Cultivar									
Herbicides (a.i. g ha $^{-1}$)	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
Control	20.97	22.02	36.99	34.28	21.16	29.13	11.88	22.18	12.94	55.57
Dimethenamid										
1125.0	23.74	20.13	27.10	32.03	17.85	24.47	14.95	22.26	14.24	59.36
2250.0	20.54	19.91	25.62	34.29	21.47	19.64	15.92	21.32	12.18	61.62
Flumetsulam + metolachlor										
1550.0	17.13	23.38	32.36	28.94	18.15	25.05	10.03	19.51	10.79	66.90
3100.0	16.75	22.06	31.39	26.83	13.05	23.09	8.49	11.04	8.56	53.39
Imazethapyr										
50.0	24.72	21.43	34.02	34.56	18.89	30.08	15.78	23.79	14.64	61.73
100.0	19.69	20.24	26.19	33.50	21.54	28.53	12.19	21.83	10.58	68.46
Metazachlor										
800.0	26.11	21.53	37.25	29.53	20.00	25.81	12.80	21.76	15.57	60.04
1600.0	19.61	19.76	30.76	25.35	17.63	22.99	12.41	21.48	10.87	58.58
Metolachlor										
1860.0	20.17	19.26	33.92	36.38	17.51	26.42	12.91	20.40	13.38	50.25
3720.0	17.44	18.03	29.54	27.55	16.94	25.22	11.73	16.44	8.80	70.14

Table 2A Effect of various herbicides on aboveground dry mass (g per plant) of ten dry bean cultivars

	Cultivar									
Herbicides (a.i. g ha $^{-1}$)	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
Control	0.55	0.87	1.63	1.59	0.73	1.53	0.79	0.87	1.27	1.19
Dimethenamid										
1125.0	0.49	0.58	0.83	1.16	0.73	1.18	0.62	0.57	1.19	1.10
2250.0	0.53	0.81	0.95	1.27	0.79	1.07	0.70	1.10	1.16	1.43
Flumetsulam + metolachlor										
1550.0	0.67	0.73	1.07	1.59	0.77	1.30	0.62	0.92	1.26	1.43
3100.0	0.41	0.89	1.29	1.21	0.82	1.11	0.46	0.87	1.24	1.35
Imazethapyr										
50.0	0.57	0.92	1.39	1.44	0.72	1.56	0.73	0.91	1.39	1.40
100.0	0.58	0.86	1.48	1.22	1.01	1.43	0.68	0.73	1.42	1.61
Metazachlor										
800.0	0.47	0.88	0.94	1.27	0.76	1.06	0.73	0.83	0.95	1.27
1600.0	0.45	0.71	1.17	1.18	0.79	1.12	0.61	0.55	0.98	1.22
Metolachlor										
1860.0	0.68	0.94	1.31	1.28	0.94	1.16	0.81	0.67	1.07	1.46
3720.0	0.59	0.74	1.09	1.19	0.90	1.61	0.64	0.80	1.23	1.61

Table 3A Effect of various herbicides on 100-seed mass (g) of ten dry bean cultivars

	Cultivar									
Herbicides (a.i. g ha $^{-1}$)	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
Control	19.67	24.73	57.47	64.07	30.07	55.40	20.93	20.97	40.73	116.73
Dimethenamid										
1125.0	18.67	25.60	59.09	63.60	26.93	57.60	22.47	22.13	42.87	117.80
2250.0	18.13	25.07	59.80	65.53	28.53	57.87	22.20	22.40	42.67	116.80
Flumetsulam + metolachlor										
1550.0	18.13	24.87	59.80	65.60	29.07	56.73	22.27	20.40	40.27	110.85
3100.0	18.20	24.47	60.98	64.73	27.40	56.67	21.60	21.67	42.00	105.73
Imazethapyr										
50.0	19.07	24.67	61.13	67.47	29.80	57.67	21.17	23.47	42.00	124.73
100.0	19.13	24.33	58.13	63.60	27.00	58.27	21.40	21.93	42.53	124.80
Metazachlor										
800.0	19.33	23.87	59.07	64.47	29.73	57.77	22.53	21.33	40.13	124.80
1600.0	17.40	22.00	57.00	66.07	28.80	57.33	21.73	20.60	39.73	110.40
Metolachlor										
1860.0	18.50	25.33	61.67	66.93	28.20	57.00	21.77	22.00	42.73	126.27
3720.0	18.67	25.57	56.33	65.60	28.27	57.33	21.30	20.93	41.70	128.67

Table 4A Effect of various herbicides on seed yield (kg ha^{-1}) of one dry bean cultivar

	Locality			
Herbicides (a.i.)	**Chrissiesmeer**	**Lichtenburg**	**Potchefstroom**	**Reitz**
Control	2544	1888	2343	1661
Dimethenamid	2585	1709	2425	1652
Flumetsulam+ metolachlor	2406	1485	2167	1682
Imazethapyr	2217	1618	2453	1442
Metazachlor	2371	1819	2177	1818
Metolachlor	2488	1710	2256	1572
Flumioxazin	2140	1114	2102	0

Table 5A Effect of various herbicides on 100-seed mass (g) of one dry bean cultivar

	Locality			
Herbicides (a.i.)	**Chrissiesmeer**	**Lichtenburg**	**Potchefstroom**	**Reitz**
Control	15.63	18.40	19.33	16.50
Dimethenamid	15.73	17.63	20.17	16.87
Flumetsulam+ metolachlor	15.17	18.27	19.43	17.07
Imazethapyr	15.40	17.27	20.00	16.57
Metazachlor	15.57	16.93	19.97	17.03
Metolachlor	15.27	17.67	20.23	16.57
Flumioxazin	16.40	17.53	19.57	–

APPENDIX B

Contents: Abbreviated analysis of variance (ANOVA) tables

Table 1B Analysis of variance of seed yield of ten dry bean cultivars exposed to different herbicides

		Seed yield at harvest (% of control data)		
Source	**DF**	**MS**	**F-value**	**PR>F**
Replicate	2	164.1		
Herbicide(H)	4	2571.9	8.54	0.005
Error	8	301.0		
Rate(R)	1	7513.4	18.29	<0.001
Cultivar(C)	9	2502.8	15.61	<0.001
HxR	4	368.1	0.9	0.468
CxH	36	508.6	1.24	0.183
RxC	9	522.9	1.27	0.254
HxR xC	36	282.1	0.69	0.909
Error	186	410.9		
Total	295			
C.V (%)	21.5			

Table 2B Analysis of variance of the aboveground dry mass 21 days after planting of ten dry bean cultivars exposed to different herbicides

	Top growth dry mass 21 days after planting (% of control data)			
Source	**DF**	**MS**	**F-value**	**PR>F**
Replicate	2	182.8		
Herbicide(H)	4	3354.5	26.36	<0.001
Error	8	127.3		
Rate(R)	1	3.4	0.01	0.906
Cultivar(C)	9	6331.0	25.80	<0.001
HxR	4	1140.5	5.65	<0.001
CxH	36	337.3	1.37	0.091
RxC	9	492.2	2.01	0.041
HxR xC	36	468.9	1.91	0.003
Error	190	245.4		
Total	299			
C.V (%)	16.9			

Table 3B Analysis of variance of the 100-seed mass of ten dry bean cultivars exposed to different herbicides

	100-Seed mass (% of control data)		
Source	**DF**	**MS**	**F-value**	**PR>F**
Replicate	2	110.05		
Herbicide(H)	4	113.22	2.41	0.135
Error	8	47.01		
Rate(R)	1	223.35	8.39	0.004
Cultivar(C)	9	415.61	15.61	<0.001
HxR	4	48.38	1.82	0.127
CxH	36	51.34	1.93	0.003
RxC	9	11.50	0.43	0.917
HxRxC	36	23.19	0.87	0.680
Error	186	26.63		
Total	295			
C.V (%)	5.1			

Table 4B Analysis of variance of the seed yield of one dry bean cultivar (Helderberg) exposed to different herbicides on four soils

	Seed yield (% of control data)			
Source	**DF**	**MS**	**F-value**	**PR>F**
Herbicide(H)	5	2839.5	14.34	<0.001
Locality(L)	3	952.8	4.81	0.006
HxL	15	991.5	5.01	<0.001
Block	2	116.5	0.59	0.782
Error	46	198.1		
Total	71			
C.V (%)	15.8			

Table 5B Analysis of variance of the 100-seed mass of one dry bean cultivar (Helderberg) exposed to different herbicides on four soils

	100-Seed mass (% of control data)			
Source	**DF**	**MS**	**F-value**	**PR>F**
Treatment	5	7.84	0.78	0.574
Locality	3	205.04	20.29	<0.001
TxL	14	17.85	1.77	0.082
Replicate/L	8	100.56	9.95	<0.001
Error	38	10.11		
Total	68			
C.V (%)	3.2			

Table 6B Analysis of variance of the herbicide-induced changes in Fo of the primary leaves of Kranskop and OPS-RS1

		Fo of primary leaves		
Source	**DF**	**MS**	**F-value**	**PR>F**
Cultivar	1	105531	9.21	0.004
Herbicide	6	47977	4.19	0.002
Cultivar x Herbicide	6	47781	4.17	0.002
Error	42	11454		
Total	55			
C.V. (%)	11			

Table 7B Analysis of variance of the herbicide-induced changes in Fm of the primary leaves of Kranskop and OPS-RS1

		Fm of primary leaves		
Source	**DF**	**MS**	**F-value**	**PR>F**
Cultivar	1	6579	0.07	0.787
Herbicide	6	127255	1.43	0.227
Cultivar x Herbicide	6	326891	3.67	0.005
Error	42	89116		
Total	55			
C.V. (%)	8.4			

Table 8B Analysis of variance of the herbicide-induced changes in Fv/Fm of the primary leaves of Kranskop and OPS-RS1

		Fv/Fm of primary leaves		
Source	**DF**	**MS**	**F-value**	**PR>F**
Cultivar	1	0.00949	15.62	<0.001
Herbicide	6	0.00215	3.54	0.006
Cultivar x Herbicide	6	0.00073	1.21	0.321
Error	42	0.00061		
Total	55			
C.V. (%)	3.4			

Table 9B Analysis of variance of the herbicide-induced changes in Fo of the trifoliate of Kranskop and OPS-RS1

		Fo of trifoliate		
Source	**DF**	**MS**	**F-value**	**PR>F**
Cultivar	1	51062	8.24	0.006
Herbicide	6	16932	2.73	0.025
Cultivar x Herbicide	6	17692	2.85	0.020
Error	42	6198		
Total	55			
C.V. (%)	9.8			

Table 10B Analysis of variance of the herbicide-induced changes in Fm of the trifoliate of Kranskop and OPS-RS1

		Fm of trifoliate		
Source	**DF**	**MS**	**F-value**	**PR>F**
Cultivar	1	311559	2.64	0.111
Herbicide	6	193710	1.64	0.159
Cultivar x Herbicide	6	248933	2.11	0.072
Error	42	117874		
Total	55			
C.V. (%)	9.8			

Table 11B Analysis of variance of the herbicide-induced changes in Fv/Fm of the trifoliate of Kranskop and OPS-RS1

		Fv/Fm of trifoliate		
Source	**DF**	**MS**	**F-value**	**PR>F**
Cultivar	1	0.00102	1.20	0.279
Herbicide	6	0.00084	0.98	0.448
Cultivar x Herbicide	6	0.00054	0.64	0.697
Error	42	0.00085		
Total	55			
C.V. (%)	3.8			

Table 12B Analysis of variance of the above ground dry mass of Kranskop and OPS-RS1 exposed to the recommended herbicide dosages

	Aboveground dry mass			
Source	**DF**	**MS**	**F-value**	**PR>F**
Cultivar	1	0.75214	33.14	<0.001
Herbicide	6	0.40851	18.00	<0.001
Cultivar x Herbicide	6	0.11772	5.19	<0.001
Error	42	0.02269		
Total	55			
C.V. (%)	19.6			

Table 13B Analysis of variance of the germination of cv Helderberg exposed to three times the recommended herbicide dosages

	Germination			
Source	**DF**	**MS**	**F-value**	**PR>F**
Herbicide	5	1.7889	3.93	0.031
Error	10	0.4556		
Total	17			
C.V. (%)	15.4			

Table 14B Analysis of variance of the plant height of cv Helderberg exposed to three times the recommended herbicides dosages

		Plant height		
Source	**DF**	**MS**	**F-value**	**PR>F**
Herbicide	5	12.3156	20.74	<0.001
Error	10	0.5939		
Total	17			
C.V. (%)	15.9			

Table 15B Analysis of variance of the above ground dry mass of cv Helderberg exposed to three times the recommended herbicide dosages

		Aboveground dry mass		
Source	**DF**	**MS**	**F-value**	**PR>F**
Herbicide	5	0.043208	13.77	<0.001
Error	10	0.003138		
Total	17			
C.V. (%)	42.2			

APPENDIX C

Contents: Rainfall, temperatures and composition of nutrient solutions tables

Table 1C Rainfall and mean daily maximum and minimum temperatures recorded at Potchefstroom for the period November 1996 to March 1997 (Chapter 2 & 3)

Period	Rainfall (mm)	Temperature (° C)	
		Max.	Min.
Nov. 1996	97.6	27	13.3
Dec.	145.8	29	15.8
Jan. 1997	48.9	28.2	16.2
Feb.	38.6	30.2	15.9
Mar.	173.4	24.2	14.2
Total rainfall	504.3		

Table 2C Rainfall and mean daily maximum and minimum temperatures recorded at Chrissiesmeer for the period November 1996 to March 1997 (Chapter 3)

Period	Rainfall (mm)	Temperature (° C)	
		Max.	Min.
Nov. 1996	22	23.4	11.2
Dec.	158	24.3	12.8
Jan. 1997	68	23.8	13.5
Feb.	38	26.2	13.4
Mar.	115	24.3	12.1
Total rainfall	401		

Table 3C Rainfall and mean daily maximum and minimum temperatures recorded at Lichtenburg for the period November 1996 to March 1997 (Chapter 3)

Period	Rainfall (mm)	Temperature (° C)	
		Max.	Min.
Nov. 1996	104	26.1	12.9
Dec.	109	27.8	15.3
Jan. 1997	97	27.4	16.1
Feb.	93	28.5	15.1
Mar.	238	23.0	14.0
Total rainfall	641		

Table 4C Rainfall and mean daily maximum and minimum temperatures recorded at Reitz for the period November 1996 to March 1997 (Chapter 3)

Period	Rainfall (mm)	Temperature (° C)	
		Max.	Min.
Nov. 1996	105	23.9	10.8
Dec.	96	26.4	13.5
Jan. 1997	194	26.1	14.7
Feb.	30	27.8	14.0
Mar.	149	22.8	13.3
Total rainfall	574		

Table 5C Composition of Multifeed - P® and Chemicult® nutrient solutions used in pot experiments

Solution	Element	Concentration
Multifeed-P®	N	19%
	P	8.20%
	K	15.80%
	Mg	900 g L
	Zn*	350 g L
	B	1000 g L
	Mo	70 g L
	Fe*	750 g L
	Mn*	300 g L
	Cu*	75 g L
Chemicult®	N	6.50%
	P	2.70%
	K	13%
	Ca	7%
	Mg	2.20%
	S	7.50%
	Fe	0.15%

Mn	0.024%
B	0.024%
Zn	0.005%
Cu	0.002%
Mo	0.001%

* chelated