REMSpC Report 2004-01
Feb 08, 2004
Updated May 12, 2004

GRAINALYSIS Manual

REMSpC Spray Consulting
12 Welsh Dr, RR3
Ayr, ON Canada
N0B 1E0

REMSpC

www.REMSpC.com

Grainalysis is a freeware program from REMSpC that can be used to analyse deposit characteristics from granular applications. **Grainalysis** provides a complete analysis of deposit variability along each sample line. When both weight and granular count are recorded at each sample site, the variability in the number density of granules and in granular uniformity (weight effects {size, specific gravity)) are also presented. For field trials that include collocated pans of mosquito larvae, relationships are derived to compare larval mortality with measured deposit. In all cases, measured mortality is adjusted using Abbott's formula to take into account mortality within a control sample.

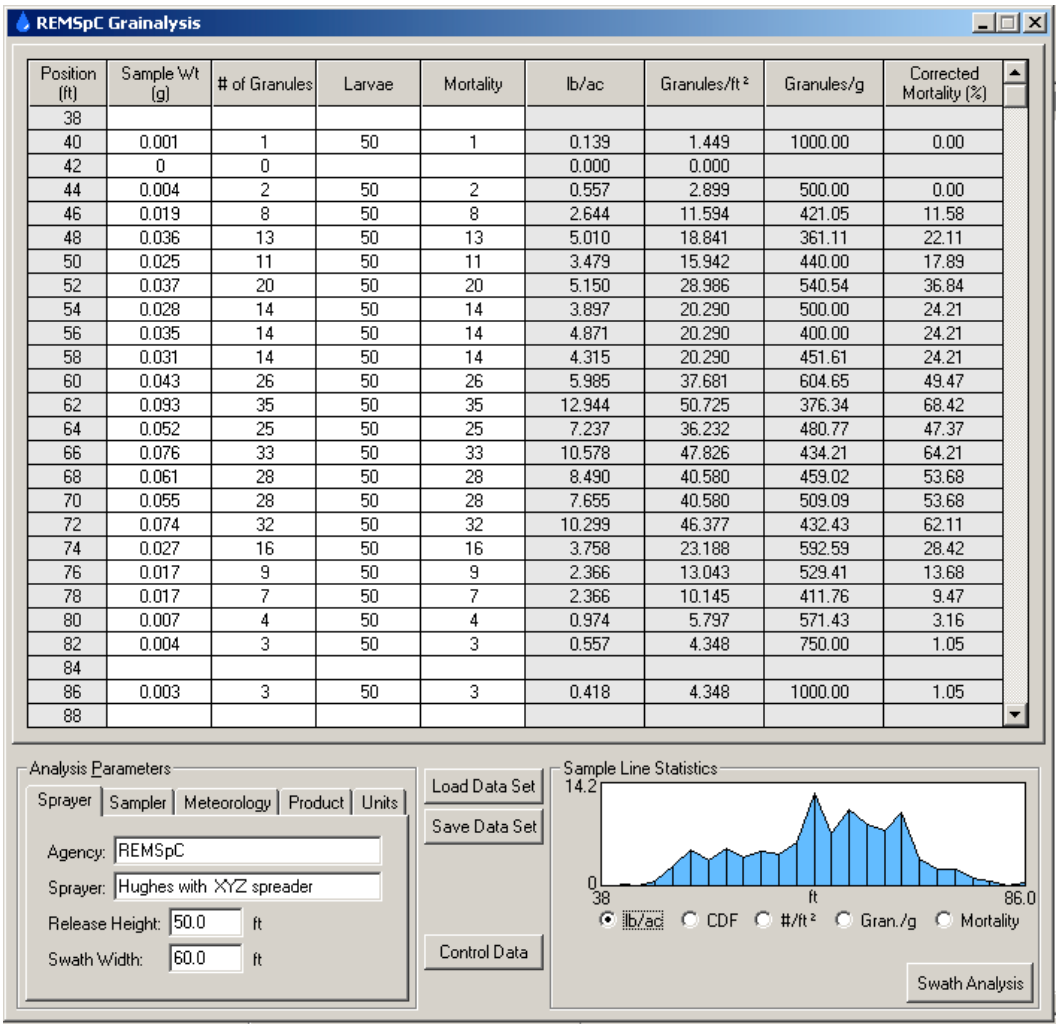
As with any analysis software, Grainalysis simply summarizes the data it is given. To ensure accurate results, sample line design should ensure a representative collection of granules within a known area. Also, care should be taken to ensure that sampler design eliminates loss of granules through bounce.

Any questions regarding this program should be directed to Grainalysis@REMSpC.com

Installing the Program

Grainalysis is freeware that can be downloaded from www.REMSpC.com. Running the downloaded package will install the program onto your computer, typically in C:\Program Files\Grainalysis\ .

Main Page



Position (ft)	Sample Wt (g)	# of Granules	Larvae	Mortality	lb/ac	Granules/ft²	Granules/g	Corrected Mortality (%)
38								
40	0.001	1	50	1	0.139	1.449	1000.00	0.00
42	0	0			0.000	0.000		
44	0.004	2	50	2	0.557	2.899	500.00	0.00
46	0.019	8	50	8	2.644	11.594	421.05	11.58
48	0.036	13	50	13	5.010	18.841	361.11	22.11
50	0.025	11	50	11	3.479	15.942	440.00	17.89
52	0.037	20	50	20	5.150	28.986	540.54	36.84
54	0.028	14	50	14	3.897	20.290	500.00	24.21
56	0.035	14	50	14	4.871	20.290	400.00	24.21
58	0.031	14	50	14	4.315	20.290	451.61	24.21
60	0.043	26	50	26	5.985	37.681	604.65	49.47
62	0.093	35	50	35	12.944	50.725	376.34	68.42
64	0.052	25	50	25	7.237	36.232	480.77	47.37
66	0.076	33	50	33	10.578	47.826	434.21	64.21
68	0.061	28	50	28	8.490	40.580	459.02	53.68
70	0.055	28	50	28	7.655	40.580	509.09	53.68
72	0.074	32	50	32	10.299	46.377	432.43	62.11
74	0.027	16	50	16	3.758	23.188	592.59	28.42
76	0.017	9	50	9	2.366	13.043	529.41	13.68
78	0.017	7	50	7	2.366	10.145	411.76	9.47
80	0.007	4	50	4	0.974	5.797	571.43	3.16
82	0.004	3	50	3	0.557	4.348	750.00	1.05
84								
86	0.003	3	50	3	0.418	4.348	1000.00	1.05
88								

The main page of Grainalysis contains three main sections: a spreadsheet for entry/display of the data set, a frame containing the analysis parameters used in the field trial and a frame displaying sample line statistics. The Swath Analysis function provides insight into deposit variability across a block from which the best swath width can be determined.

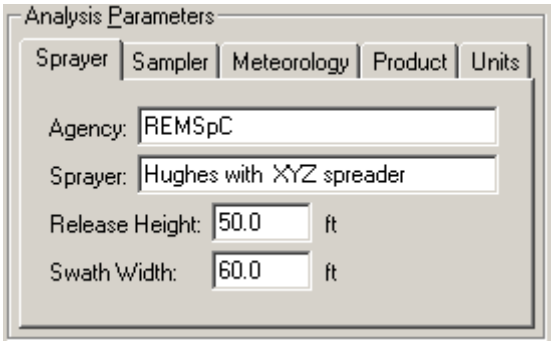
Data Entry

Previous Data Set

Data from previous Grainalysis sessions can be loaded by clicking the **Load Data Set** button. Data files contain all trial parameters as well as all granular and mortality data as previously entered.

New Data Set

Analysis Parameters



For each data set, certain parameters describing the field trial should be tabulated. Information describing a trial falls into 5 categories:

Sprayer include information on

Agency

Sprayer – details such as aircraft & spreader type

Release Height – height of aircraft above ground

Swath Width – swath used when calibrating the flow rate (lb/min) for the desired application rate

Sampler description of sampler type used

Opening – description of sampler opening. Options include circular, square, rectangular, multi-sided

Area – area of sampler opening in ft^2 or m^2

Position 1 – most negative sampler position relative to flight line. Distances to pilot's right of the spray line are positive, to the left are negative; the spray line being marked by position 0

Separation – distance between samplers

Note:

Sample weight is always entered as grams. Deposit is calculated as

$$lb/ac = \frac{\text{gm} \times 96.006}{\text{Opening area}\left(ft^2\right)}$$

$$kg/ha = \frac{\text{gm} \times 10}{\text{Opening area}\left(m^2\right)}$$

Meteorology meteorology at site during trial

Height – height of met sensors

Air Temperature

RH – Relative Humidity

Wind Speed

Wind Direction – wind direction relative to spray line

- 0^o – spray line into wind
- 90^o – crosswind with wind striking right-hand side of aircraft
- 180^o – spray line with the wind
- 270^o – crosswind with wind striking left-hand side of the aircraft

Product

Product – product name, manufacturer

Product Rate – total weight of product being applied per acre or hectare (lb/ac, kg/ha)

Units

Metric – metres, litres, hectares

US – feet, US oz, acres

Note: Changing units will alter appropriate data.

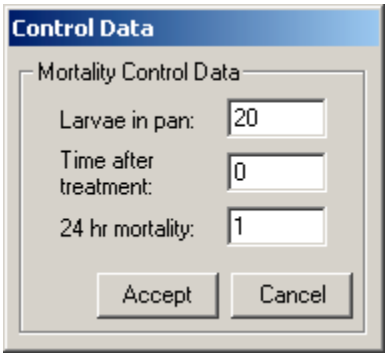
Data Entry

As data are added from a new trial, the analysis output columns and sample line statistics plot are automatically updated. Sampler distances are pre-set based on the position of the first sampler and distance between samplers. Distances to the right of the spray line are positive, to the left are negative; the spray line being marked by position 0. All data should be entered including sites with no (0) deposit.

Data to be entered include:

Sample Weight	– weight (gm) of granules at each sample site
# of Granules	– # of granules in the sampler
Larvae	– total number of larvae in the pan
Mortality	– number of dead larvae in the pan

Mortality Information



If the field trial includes larval pans at each sample site, control mortality must also be entered. Good field practice should limit control mortality (handling stress) to less than 10%. Larval mortality in each pan is corrected by control mortality using Abbott's formula. These data are used to develop a relationship between deposit and larval mortality. Although larval mortality from an equivalent deposit during operational programs may be less (i.e. organic matter), derived relationships can be used to assist in an overall operational evaluation.

The ability to load a previous data set into Grainalysis allows mortality information to be entered at a later date, after the slide data have been recorded. Since only a single value for mortality can be associated with each sample site, sites with collocated larval pans should be bulked and entered as a single data point. Also, larval mortality at different times after the application can be retained as separate data sets by loading the deposit data set, modifying the mortality data and saving the results under a new output file name.

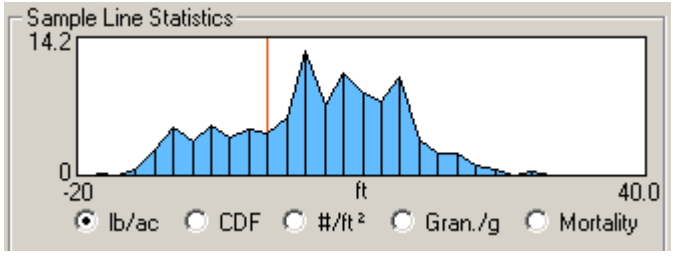
Analysis Output

As site data (weight, # of granules, larval mortality) are entered, deposit and efficacy statistics are continuously updated. Output is presented in two forms:

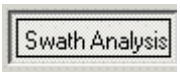
Site-Specific Data

Site-specific output provides information on deposit mass (kg/ha, lb/ha) and granular density (granules/unit area) at each sample site. When both weight (gm) and number of granules at each sample site are entered, granular uniformity (granules/gram of product) is also displayed. Since larvicides are generally contained on the surface of the granular carrier, this number can be used to infer uniformity of active ingredient across the sampling grid. Calculated mortality (%) includes a correction to account for mortality in the controls by applying Abbott's formula.

Sample Line Statistics



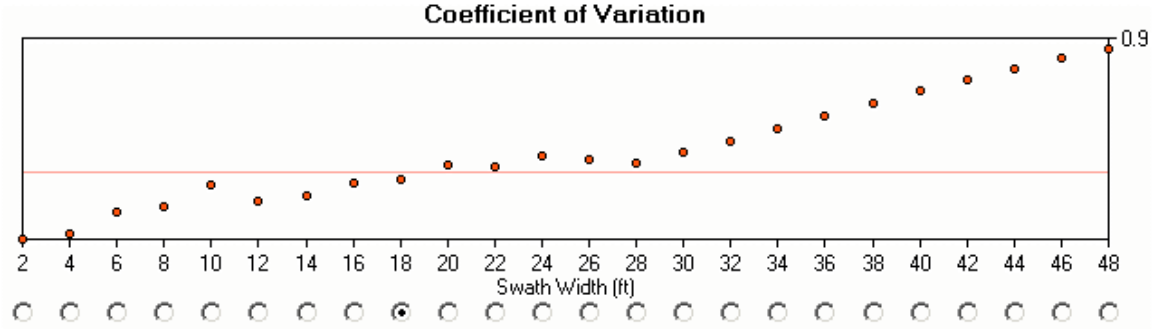
In the **Sample Line Statistics** panel, the spatial variation of deposit (kg/ha, lb/ac), cumulative deposit fraction (CDF), granular density (# of granules/unit area), granular uniformity (granules/gram of product) and mortality along the sample line can be viewed by clicking on the appropriate selection. The vertical red line indicates the zero position (spray line).



Swath Analysis

With the Swath Analysis function, the user can evaluate the impact of swath width on deposit variability across a block. A race-track application is assumed. Deposit (kg/ha, lb/ac) or granular density (granules/unit area) variability can be viewed by choosing the appropriate radio button.

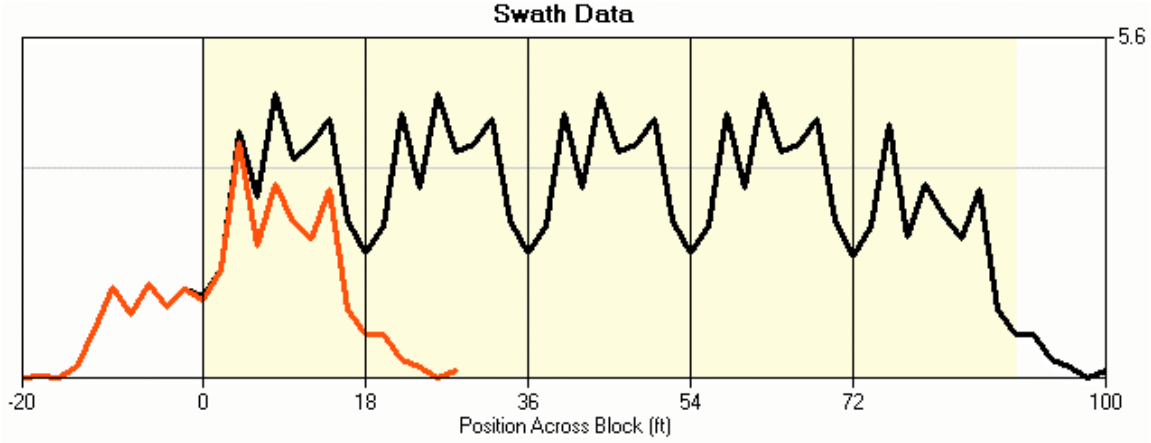
Coefficient of Variation



The coefficient of variation (COV) is plotted for each swath width ranging from sampler separation to the length of the sample line. COVs are referenced to 0.3 (red line), the industry standard for acceptable deposit variability. Displayed below the Sample Line Statistics graph are the COV, average deposit and maximum/minimum deposit that would result from the chosen swath width (shown at top). Coefficient of Variation and listed statistics are for deposit near the

centre of the block. Deposit or number-density variability can be viewed for different swath widths. Flow rate and hence deposit is automatically scaled (using the swath width in Sprayer Parameters) in order to maintain a consistent application rate for the chosen swath width.

Deposit Profiles

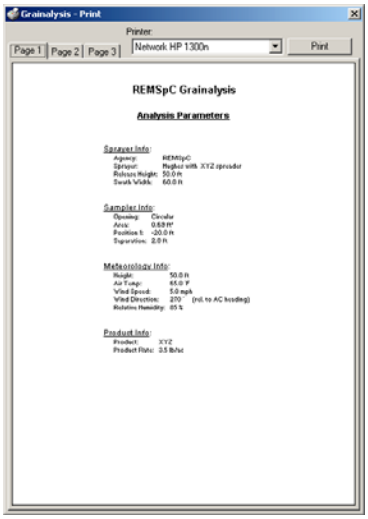


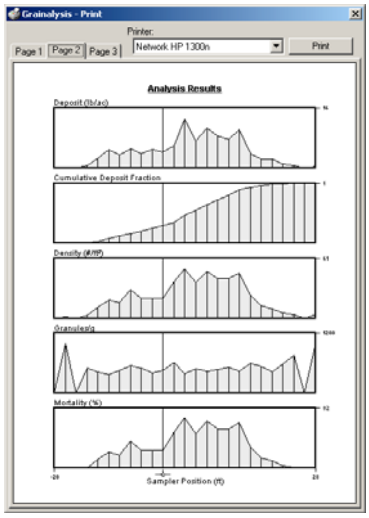
Selecting a swath width (radio button) produces a hypothetical profile of deposit or granular density across a multi-swath block (indicated by the pale yellow background). Vertical lines reflect the flight lines across the block. Position '0' is the edge of the block and first flight line location. Total deposit (thick black line) is plotted, as is the field data from a single pass (thick red line). By varying the swath (track spacing) and hence COV, the influence of overlapping swaths from adjacent treatment lines on deposit uniformity can be examined. Comparing block variability for deposit (lb/ac) and granular density (granules/unit area) provides insight into the impact of different swath widths on these two parameters. Visualising deposit with respect to block boundaries provides insight into the need for swath offsets and/or overlapping spray lines in order to even out deposit on the upwind side of a block.

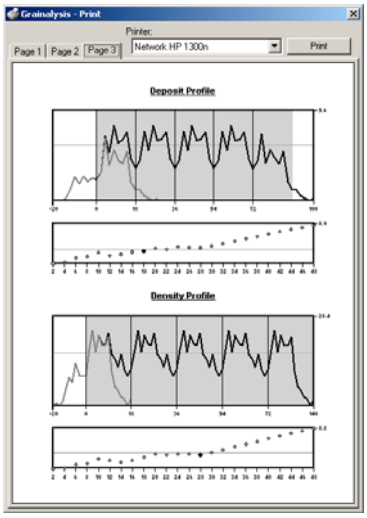
Printing Summary Analyses

Clicking the print button opens a print preview of each output page. Printed output includes

- Analysis Parameter summary
- Sample Line Statistics
- Analysis of COV and block variability for deposit and number density of granules for the chosen swath widths







Saving Data to Output File

Saves the data for future retrieval. Grainalysis saves files as Comma-Separated Value files (CSV), a common file format that can also be loaded into virtually any spreadsheet program (ie. MS Excel). An example is given in Appendix 1. The output file contains the analysis parameters, the raw and statistical data for each site along the sample line and the block variability of deposit and granular density for the chosen swath widths. In the file, block boundaries are indicated by ==== while flight line locations are represented by ----------.

Appendix 1

Sample of Grainalysis CSV File

==========
REMSpC Grainalysis
==========

Analysis Parameters

Units:	U.S.	
Agency:	REMSpC	
Sprayer:	Hughes with XYZ spreader	
Release Height:	50	ft
Swath Width:	60	ft
Opening Type:	Circular	0
Opening Area:	0.69	ft²
Position 1:	-20	ft
Separation:	2	ft
Height:	50	ft
Air Temp.:	65	°F
Wind Speed:	5	mph
Wind Direction:	270	°
Rel. Humidity:	85	%
Product:	XYZ	
Spray Rate:	3.5	lb/ac

Mortality Control Data

Number in pan:	20
Time after treatment:	20
24 hr mortality:	1

Granular Data

Position (ft)	Sample Wt (g)	# of Granules	Larvae	Mortality	Deposit (lb/ac)	Gran./ft²	Gran./g	Corrected Mort. (%)
-20	0	0			0	0		
-18	0.001	1	50	1	0.139	1.449	1000	0

-16	0	0			0	0		
-14	0.004	2	50	2	0.557	2.899	500	0
-12	0.019	8	50	8	2.644	11.594	421.05	11.58
-10	0.036	13	50	13	5.01	18.841	361.11	22.11
-8	0.025	11	50	11	3.479	15.942	440	17.89
-6	0.037	20	50	20	5.15	28.986	540.54	36.84
-4	0.028	14	50	14	3.897	20.29	500	24.21
-2	0.035	14	50	14	4.871	20.29	400	24.21
0	0.031	14	50	14	4.315	20.29	451.61	24.21
2	0.043	26	50	26	5.985	37.681	604.65	49.47
4	0.093	35	50	35	12.944	50.725	376.34	68.42
6	0.052	25	50	25	7.237	36.232	480.77	47.37
8	0.076	33	50	33	10.578	47.826	434.21	64.21
10	0.061	28	50	28	8.49	40.58	459.02	53.68
12	0.055	28	50	28	7.655	40.58	509.09	53.68
14	0.074	32	50	32	10.299	46.377	432.43	62.11
16	0.027	16	50	16	3.758	23.188	592.59	28.42
18	0.017	9	50	9	2.366	13.043	529.41	13.68
20	0.017	7	50	7	2.366	10.145	411.76	9.47
22	0.007	4	50	4	0.974	5.797	571.43	3.16
24	0.004	3	50	3	0.557	4.348	750	1.05
26	0	0			0	0		
28	0.003	3	50	3	0.418	4.348	1000	1.05
30	0	0			0	0		
32	0	0			0	0		
34	0	0			0	0		
36	0	0			0	0		
38	0	0			0	0		
40	0	0			0	0		

-
Swath Analysis

-

Selected Swath Widths:

Deposit: 18ft Density: 28ft

Swath Width	COV	Deposit (lb/ac) Max	Mean	Min	COV	Density (#/ft²) Max	Mean	Min
2	0	3.46	3.46	3.46	0	16.71	16.71	16.71
4	0.02	3.51	3.46	3.41	0.01	16.81	16.71	16.62
6	0.12	3.81	3.46	3.01	0.08	18.12	16.71	15.65
8	0.15	3.99	3.46	3.01	0.09	18.36	16.71	14.88
10	0.24	4.82	3.46	2.57	0.18	21.74	16.71	13.77
12	0.17	4.26	3.46	2.98	0.15	20.58	16.71	13.91
14	0.2	4.74	3.46	2.89	0.12	19.28	16.71	14.2
16	0.25	4.79	3.46	2.15	0.16	19.32	16.71	11.59
18	0.27	4.68	3.46	2.05	0.21	20.87	16.71	10.43
20	0.33	5.15	3.46	2.23	0.28	25.12	16.71	10.14
22	0.32	5.05	3.46	1.94	0.26	22.85	16.71	9.57

24	0.37	6.12	3.46	1.95	0.29	26.09	16.71	9.86
26	0.35	5.61	3.46	1.87	0.29	25.12	16.71	8.79
28	0.34	6.04	3.46	2.08	0.27	23.67	16.71	9.47
30	0.39	6.47	3.46	1.95	0.31	25.36	16.71	10.14
32	0.44	6.9	3.46	1.56	0.37	27.05	16.71	8.5
34	0.5	7.33	3.46	1.34	0.43	28.74	16.71	7.39
36	0.55	7.77	3.46	0.92	0.48	30.43	16.71	5.22
38	0.61	8.2	3.46	0.62	0.55	32.13	16.71	3.67
40	0.66	8.63	3.46	0.37	0.6	33.82	16.71	1.93
42	0.71	9.06	3.46	0	0.65	35.51	16.71	0
44	0.76	9.49	3.46	0.1	0.7	37.2	16.71	1.06
46	0.81	9.92	3.46	0	0.75	38.89	16.71	0
48	0.85	10.35	3.46	0	0.79	40.58	16.71	0
50	0.89	10.79	3.46	0	0.83	42.27	16.71	0
52	0.93	11.22	3.46	0	0.87	43.96	16.71	0
54	0.97	11.65	3.46	0	0.91	45.65	16.71	0
56	1.01	12.08	3.46	0	0.95	47.34	16.71	0
58	1.04	12.51	3.46	0	0.98	49.03	16.71	0
60	1.08	12.94	3.46	0	1.02	50.72	16.71	0

Position	Deposit			Density		
-20	0			0		
-18	0.042			0.676		
-16	0			0		
-14	0.167			1.353		
-12	0.793			5.411		
-10	1.503			8.792		
-8	1.044			7.44		
-6	1.545			13.527		
-4	1.169			9.469		
-2	1.461			9.469		
0	1.336	--------	========	9.469	--------	========
2	1.795			17.585		
4	4.05			23.672		
6	2.965			16.908		
8	4.676			22.319		
10	3.591			19.614		
12	3.841			18.937		
14	4.259			22.995		
16	2.589			16.232		
18	2.046	--------		14.879		
20	2.505			12.174		
22	4.342			16.232		
24	3.132			11.498		
26	4.676			9.469		
28	3.716			11.498	--------	
30	3.841			17.585		
32	4.259			23.672		
34	2.589			16.908		
36	2.046	--------		22.319		
38	2.505			19.614		

40	4.342			18.937	
42	3.132			22.995	
44	4.676			16.232	
46	3.716			14.879	
48	3.841			12.174	
50	4.259			16.232	
52	2.589			11.498	
54	2.046	--------		9.469	
56	2.505			11.498	--------
58	4.342			17.585	
60	3.132			23.672	
62	4.676			16.908	
64	3.716			22.319	
66	3.841			19.614	
68	4.259			18.937	
70	2.589			22.995	
72	2.004	--------		16.232	
74	2.505			14.879	
76	4.175			12.174	
78	2.338			16.232	
80	3.173			11.498	
82	2.672			9.469	
84	2.296			11.498	--------
86	3.09			17.585	
88	1.127			23.672	
90	0.71		========	16.908	
92	0.71			22.319	
94	0.292			19.614	
96	0.167			18.937	
98	0			22.995	
100	0.125			16.232	
102	0			14.879	
104	0			12.174	
106	0			16.232	
108	0			11.498	
110	0			9.469	
112	0			11.498	--------
114	0			17.585	
116	0			23.672	
118	0			16.908	
120	0			22.319	
122	0			18.937	
124	0			18.937	
126	0			21.643	
128	0			10.821	
130	0			6.087	
132	0			4.734	
134	0			2.705	
136	0			2.029	
138	0			0	
140	0			2.029	========

142	0	0
144	0	0
146	0	0
148	0	0
150	0	0
152	0	0