MASTER - STAT. ANALYSES

HNS 17b
1989
(Year 2)

HDC Project HO/17/b/1989

Experimental design

The experiment comprised a 2 x 2 x 3 factorial arranged as a split-split plot in four complete replicates. Treatments consisted of two cultivars (Myretoun Ruby & Anne Sparkes), two composts (C1 & C2) and three fungicides (referred to simply as 1, 2 & 3). Within each replicate fungicides were randomised as main plots; composts were randomised within fungicides as sub-plots; and cultivars within composts as sub-sub-plots. Each experimental plot comprised 72 plants which were classified as Grades 1, 2 or 3(Dead). Plants in Grades 1 and 2 were also classified for level of moss/liverwort infestation: 1.little or none; 2.moderate to severe.

Method of analysis

Simple summary tables of the data are presented in which the total numbers of plants (across 4 replicates) are given for the two classifications (Grade x infestation) cross-classified by the three treatment factors. Marginal tables are also presented for the single classifications (summed across the other classifying factor).

Five variates were identified for analysis:

(1) Total number of Grade 1 plants;
(2) Number of plants with little or no liverwort;
(3) Total number of dead plants;
(4) Number of Grade 1 plants with little or no liverwort;
(5) Number of Grade 2 plants with little or no liverwort;

Given the relatively small number of plants that fell into Grade 3, classification of plants into Grades 1 and 2 can be regarded as complementary, so that separate analyses are unnecessary: %Grade 1 is approximately equal to 1 - %Grade 2.

Analysis can take two forms: analysis of variance or binomial analysis. However, the two forms should be essentially similar.
ANOVA - Using an angular transformation for percentages, the analyses takes the form of a split-split-plot. For variates 4 and 5 this analysis is not strictly correct because the denominator is variable.
BINOMIAL - This is similar to analysis of variance in terms of output but is a more exact test of the differences between the proportions. For each variate both analyses are printed, though this only serves to demonstrate the similarity between them. After the analysis of deviance table there is also a table of 'so-called' predictions, which is in fact the corresponding proportion of total plants falling into that classification. This table is the most useful summary. I have not troubled to present transformed means and standard errors, the table of proportions together with the statements of significance is sufficient.

Results
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(1) Total number of Grade 1 plants. Both analyses show marked differences between cultivars (M.R. > A.S.) and between composts (C2 > C1). There is also the suggestion of a fungicide effect: significant in one analysis but not in the other.

(2) Number of plants with little or no liverwort. Here the fungicide effect is enormous, with fungicide 2 inhibiting liverwort growth on 80% of plants on C1 and 94% on C2. The compost effect is also highly significant, and there is a small but significant cultivar response. As in the first analysis the effects are simple, i.e. there are no interactions.

(3) Total number of dead plants. This analysis shows only one significant effect: the cultivar x compost interaction. Examination of either the table of totals or the table of proportions shows that cv. Myretoun Ruby is more at risk on compost C1, and that Anne Sparkes is more at risk on compost C2.

(4,5) Number of Grade 1,2 plants with little or no liverwort. These analysis were performed separately to see if the reponse to fungicide or compost was dependent on plant vigour. There seems to be little evidence for this as both analyses show very similar results, both in line with the analysis of 2: i.e. a very large fungicide effect, a not so large (but very significant compost effect) and only the suggestion of a difference between cultivars.

Summary Table of Total Plant Numbers cross-classified according to Grade and Moss/Liverwort infestation.

		Little or no liverwort		Moderate to severe moss/l.wort			
		Grade 1	Grade 2	Grade 1	Grade 2	Dead	Total
Compost C1							
Fung	cvar						
1	M.R.	34	9	173	63	10	289
	A.S.	8	5	168	103	4	288
2	M.R.	190	39	39	10	10	288
	A.S.	165	63	34	23	4	289
3	M.R.	87	20	123	52	7	289
	A.S.	71	36	97	82	2	288
Compost C2							
Fung	cvar						
1	M.R.	91	11	144	37	3	286
	A.S.	42	18	142	82	5	289
2	M.R.	235	41	6	3	3	288
	A.S.	203	56	8	10	9	286
3	M.R.	150	25	84	28	3	290
	A.S.	109	37	88	45	9	288

Summary Table of Total Plant Numbers cross-classified according to Grade.

		Compost C1		Compost C2	
		Grade 1	Grade 2	Grade 1	Grade 2
Fung	cvar				
1	M.R.	207	72	235	48
	A.S.	176	108	184	100
2	M.R.	229	49	241	44
	A.S.	199	86	211	66
3	M.R.	210	72	234	53
	A.S.	168	118	197	82

Summary Table of Total Plant Numbers cross-classified according to severity of moss/liverwort

		Compost C1		Compost C2	
		Slight	Heavy	Slight	Heavy
Fung	cvar				
1	M.R.	43	236	102	181
	A.S.	13	271	60	224
2	M.R.	229	49	276	9
	A.S.	228	57	259	18
3	M.R.	107	175	175	112
	A.S.	107	179	146	133

***** Analysis of variance *****

Variate: proportion of Grade 1 plants (ang transform)

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
rep stratum	3	176.57	58.86		
rep.fung stratum					
fung	2	197.22	98.61	4.26	0.071
Residual	6	138.99	23.16		
rep.fung.comp stratum					
comp	1	240.86	240.86	25.90	<.001
fung.comp	2	14.67	7.33	0.79	0.483
Residual	9	83.69	9.30		
rep.fung.comp.cvar stratum					
cvar	1	851.17	851.17	36.65	<.001
fung.cvar	2	10.68	5.34	0.23	0.797
comp.cvar	1	10.08	10.08	0.43	0.518
fung.comp.cvar	2	29.60	14.80	0.64	0.540
Residual	18	418.08	23.23		
Total	47	2171.62			

*** Accumulated analysis of deviance ***

Response variate: no. of Grade 1 plants relative to the total

Change	d.f.	deviance	mean deviance	ratio
+ rep	3	14.885	4.962	2.98
+ fung	2	17.201	8.600	5.16
Residual(1)	6	9.997	1.666	
+ comp	1	19.643	19.643	29.14
+ fung.comp	2	1.047	0.524	0.78
Residual(2)	9	6.066	0.674	
+ cvar	1	71.155	71.155	33.80
+ fung.cvar	2	0.380	0.190	0.09
+ cvar.comp	1	1.483	1.483	0.70
+ fung.cvar.comp	2	2.053	1.027	0.49
Residual(3)	18	37.888	2.105	
Total	47	181.799	3.868	

*** Predictions from regression model ***

fung	cvar comp	Myretoun	Ruby Anne	Sparkes
Fungi	C1	0.72	0.61	
	C2	0.82	0.64	
Fung2	C1	0.80	0.69	
	C2	0.84	0.74	
Fung3	C1	0.73	0.58	
	C2	0.81	0.68	

***** Analysis of variance *****

Variate: proportion of plants with little or no liverwort (ang transform)

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
rep stratum	3	2940.64	980.21		
rep.fung stratum					
fung	2	18452.26	9226.13	164.42	<.001
Residual	6	336.68	56.11		
rep.fung.comp stratum					
comp	1	2055.40	2055.40	33.59	<.001
fung.comp	2	40.88	20.44	0.33	0.725
Residual	9	550.72	61.19		
rep.fung.comp.cvar stratum					
cvar	1	358.15	358.15	6.54	0.020
fung.cvar	2	151.45	75.72	1.38	0.276
comp.cvar	1	109.38	109.38	2.00	0.175
fung.comp.cvar	2	8.64	4.32	0.08	0.924
Residual	18	985.21	54.73		
Total	47	25989.41			

*** Accumulated analysis of deviance ***

Response variate: no. of plants in Grades 1 & 2 with little or no liverwort

Change	d.f.	deviance	mean deviance	ratio
+ rep	3	145.544	48.515	10.92
+ fung	2	1222.962	611.481	137.69
Residual(1)	6	26.648	4.441	
+ comp	1	157.551	157.551	32.44
+ fung.comp	2	9.842	4.921	1.01
Residual(2)	9	43.709	4.857	
+ cvar	1	26.469	26.469	6.47
+ fung.cvar	2	15.487	7.743	1.89
+ cvar.comp	1	2.213	2.213	0.54
+ fung.cvar.comp	2	6.841	3.421	0.84
Residual(3)	18	73.648	4.092	
Total	47	1730.915	36.828	

*** Predictions from regression model ***

fung	cvar comp	Myretoun	Ruby	Anne	Sparkes
Fung1	C1	0.15		0.05	
	C2	0.36		0.21	
Fung2	C1	0.80		0.79	
	C2	0.96		0.91	
Fung3	C1	0.37		0.37	
	C2	0.60		0.51	

***** Analysis of variance *****

Variate: proportion of dead plants (ang transform)

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
rep stratum	3	209.11	69.70		
rep.fung stratum					
fung	2	8.84	4.42	0.20	0.824
Residual	6	133.10	22.18		
rep.fung.comp stratum					
comp	1	7.38	7.38	0.30	0.596
fung.comp	2	52.88	26.44	1.08	0.380
Residual	9	220.20	24.47		
rep.fung.comp.cvar stratum					
cvar	1	3.47	3.47	0.19	0.666
fung.cvar	2	17.97	8.98	0.50	0.616
comp.cvar	1	231.75	231.75	12.86	0.002
fung.comp.cvar	2	8.64	4.32	0.24	0.789
Residual	18	324.45	18.03		
Total	47	1217.82			

*** Accumulated analysis of deviance ***

Response variate: no. of dead plants relative to total.

Change	d.f.	deviance	mean deviance	ratio
+ rep	3	13.263	4.421	3.16
+ fung	2	0.628	0.314	0.22
Residual(1)	6	8.403	1.400	
+ comp	1	0.368	0.368	0.22
+ fung.comp	2	1.890	0.945	0.56
Residual(2)	9	15.202	1.689	
+ cvar	1	0.127	0.127	0.10
+ fung.cvar	2	0.687	0.344	0.27
+ cvar.comp	1	14.239	14.239	11.15
+ fung.cvar.comp	2	0.493	0.246	0.19
Residual(3)	18	22.997	1.278	
Total	47	78.297	1.666	

*** Predictions from regression model ***

fung	cvar comp	Myretoun	Ruby Anne	Sparkes
Fung1	C1	0.03	0.01	
	C2	0.01	0.02	
Fung2	C1	0.03	0.01	
	C2	0.01	0.03	
Fung3	C1	0.02	0.01	
	C2	0.01	0.03	

***** Analysis of variance *****

Variate: proportion of Grade 1 plants with little or no liverwort

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
rep stratum	3	3169.46	1056.49		
rep.fung stratum					
fung	2	21281.20	10640.60	128.05	<.001
Residual	6	498.58	83.10		
rep.fung.comp stratum					
comp	1	2420.27	2420.27	24.49	<.001
fung.comp	2	38.46	19.23	0.19	0.827
Residual	9	889.60	98.84		
rep.fung.comp.cvar stratum					
cvar	1	169.82	169.82	2.35	0.143
fung.cvar	2	238.59	119.29	1.65	0.220
comp.cvar	1	75.59	75.59	1.04	0.320
fung.comp.cvar	2	20.37	10.19	0.14	0.870
Residual	18	1303.20	72.40		
Total	47	30105.13			

*** Accumulated analysis of deviance ***

Response variate: no. of Grade 1 plants with little or no liverwort

Change	d.f.	deviance	mean deviance	ratio
+ rep	3	116.079	38.693	13.55
+ fung	2	956.104	478.052	167.44
Residual(1)	6	17.132	2.855	
+ comp	1	126.839	126.839	24.50
+ fung.comp	2	12.724	6.362	1.23
Residual(2)	9	46.597	5.177	
+ cvar	1	13.799	13.799	3.92
+ fung.cvar	2	11.385	5.692	1.62
+ cvar.comp	1	0.496	0.496	0.14
+ fung.cvar.comp	2	3.779	1.889	0.54
Residual(3)	18	63.296	3.516	
Total	47	1368.228	29.111	

*** Predictions from regression model ***

fung	cvar comp	Myretoun	Ruby	Anne	Sparkes
Fung1	C1	0.16		0.05	
	C2	0.37		0.23	
Fung2	C1	0.83		0.83	
	C2	0.98		0.96	
Fung3	C1	0.40		0.40	
	C2	0.64		0.55	

***** Analysis of variance *****

Variate: proportion of Grade 2 with little or no liverwort

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
rep stratum	3	2628.3	876.1		
rep.fung stratum					
fung	2	22323.0	11161.5	93.16	<.001
Residual	6	718.9	119.8		
rep.fung.comp stratum					
comp	1	1276.1	1276.1	10.78	0.009
fung.comp	2	3.5	1.7	0.01	0.986
Residual	9	1065.7	118.4		
rep.fung.comp.cvar stratum					
cvar	1	341.1	341.1	3.27	0.087
fung.cvar	2	234.0	117.0	1.12	0.347
comp.cvar	1	0.5	0.5	0.01	0.944
fung.comp.cvar	2	1.2	0.6	0.01	0.994
Residual	18	1874.6	104.1		
Total	47	30466.9			

*** Accumulated analysis of deviance ***

Response variate: no. of Grade 2 plants with little or no liverwort

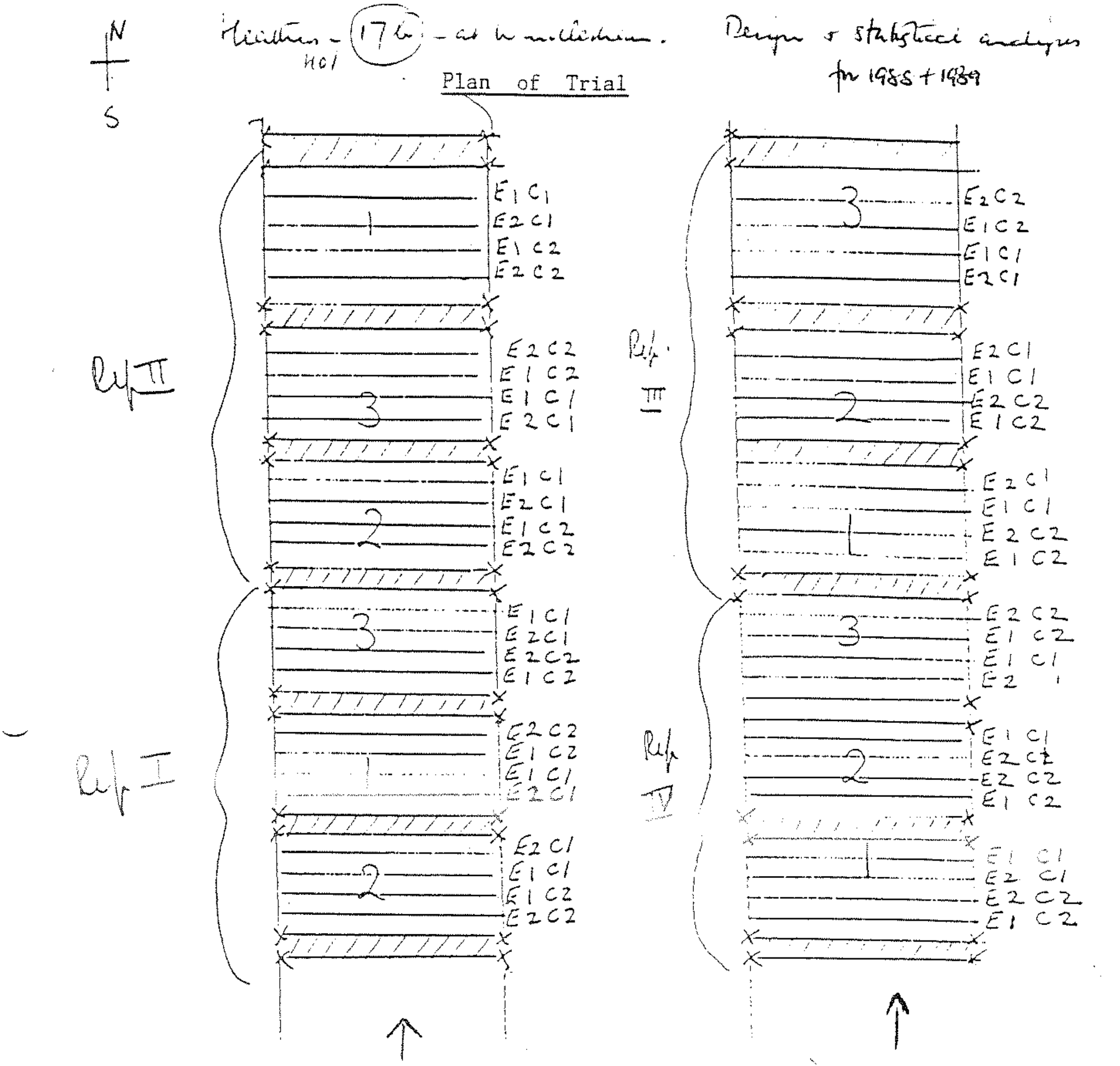
Change	d.f.	deviance	mean deviance	ratio
+ rep	3	24.783	8.261	2.82
+ fung	2	300.756	150.378	51.29
Residual(1)	6	17.589	2.932	
+ comp	1	28.101	28.101	13.42
+ fung.comp	2	1.297	0.648	0.31
Residual(2)	9	18.849	2.094	
+ cvar	1	4.662	4.662	2.52
+ fung.cvar	2	5.633	2.816	1.52
+ cvar.comp	1	0.024	0.024	0.01
+ fung.cvar.comp	2	0.864	0.432	0.23
Residual(3)	18	33.283	1.849	
Total	47	435.841	9.273	

*** Predictions from regression model ***

fung	cvar comp	Myretoun	Ruby Anne	Sparkes
Fung1	C1	0.13	0.04	
	C2	0.28	0.18	
Fung2	C1	0.82	0.71	
	C2	0.93	0.86	
Fung3	C1	0.29	0.31	
	C2	0.47	0.45	

Heathers - HO1 (176) - at ... Design & statistical analyses for 1988 + 1989

Plan of Trial



72 Rows each of 24 plants (3 rows per sub-sub plot)

14 Rows each of 24 plants as Guards (X)

Total 86 Rows

72 Rows each of 24 plants

14 rows each of 24 plants as Guards (marked X)

Total 86 Rows

E1 = E. carnea cv Myretoun Ruby

E2 = E. carnea cv Anne Sparkes

X = Calluna vulgaris cv White Lawn (guards)

C1 = Compost with Cambark and Vapo peat

C2 = Compost with Cambark, Vapo & Loam

1 = Fungicide rotation of Compass & Repulse

2 = " " " Compass & thiram

3 = Fungicide sequence of Compass, thiram, Octave, Repulse, Benlate, thiram, Compass, Elvaron, Octave.