FORESTRY COMMISSION
R&D DIVISION
SUMMARY EXPERIMENTAL RECORD

Section SILV.(N)

Form 11A

Compt No: 108 Forest/Expt: (SPEYMOUTH) THINDLAND 111 P.80

Grid ref: NJ 282536 1st 1 : 50000 Series and Sheet No: 28

Ploughing appendix.

1. Description of actual ploughing treatments.

(Ripping. A winged ripper pulled by D.7 tractor, at 2 m and 3 m spacing along planting lines, before ploughing).

(i) RS RS 60/T90/t/I 1.0(+D6) Rotary mouldboard complete, over ripping. Actual spacing of rotary furrows approx. 80 cm, mean depth of ripping 81 cm. Mean depth of plough tine - 63.1 cm.

(ii) CD S60/T90/m/I 1.0(+D7) Deep tine complete ploughing at approx. 1 m spacing. Mean depth of tine 76.9 cm.

(iii) CS S30/T90/t/I 1.0(+D6) Shallow tine complete ploughing at 0.5 - 0.6 m spacing over ripping. Mean depth of plough tine - 55.4 cm. Mean depth of ripping - 81.8 cm.

(iv) SD S60/T90/m/I 2.0 and 3.0 (+D7). Deep tine ploughing spaced at 2 and 3 m. Mean depth of tine 74.2 cm.

(v) SC CS30/T90/m/I 2.0 and 3.0 (+Fiat 80) over ripping. Shallow tine plough, left hand throw mouldboard, offset disc. Mouldboard tine running along rip channel, disc running approx. 30 cm to left, to cut hinge. Inverted turf and soil replaced by hand in furrow, still in inverted position. Mean depth of plough furrow - not tine - 50.5 cm. Mean depth of ripping - 80.5 cm.

2. Notes on Ploughing Treatments.

(i) Tractors. The Caterpillar D7 was a Conservancy tractor, ex Research, driven very ably by Cons. driver. The tracks were nearly worn out so traction was generally poor, so the deep treatments generally did not reach design or treatment specifications. The operator considered the flat tracks a positive advantage in the wettest plots. The Research D6 had 'Kamatsu' tracks which offered excellent traction and surface pressure capabilities. The Fiat 80 was Cons. supplied and driven, and perfectly adequate for the task.

(ii) Ploughs.

Rotary mouldboard (RS). In the trial area this plough was tested first with the tractor running on the land, even with the Drawbar offset, this gave a furrow spacing of 1.1 m, and in the completed job the furrows were clearly distinguishable, so it was tried with one track running in the furrow, giving a spacing of 0.8 m and giving a good result. This was the method adopted for all plots. The tilth and soil mixing obtained with this plough was most impressive. The effect of the plough was to cut and invert the vegetation - but not to pass it through the helix - then cover it with mixed and broken soil thrown up and deposited by the helix. See photo RS (4). I would anticipate fairly rapid re invasion by heather, and rapid nitrogen loss.

There were several mechanical problems - first the main bearing failed, part way through Plot 16, the first RS plot to be done. Subsequently also found the weld which held the flange on to the rotor shaft, to which the rotor was bolted, had failed. Plough was stripped and rebuilt and worked well after the second attempt to repair the weld. Plot 16 was finished and no further problems encountered. The trial area was ploughed overall with the RS to finish with.

CHB/11/80.

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Grid ref: NJ 282536 1st

1 : 50000

Series and Sheet No: 28

S60/T90/m (CD, SD).

The only problem encountered was achieving the depth, owing to the state of the tractor's tracks. Depths were about 15 cm short.

S30/T90/t (CS).

The carriage was that planned for the SC treatment, but not used, so the CS treatment is the only one using this set up. Mean depth is + 10 cm over specification for treatment.

CS30/T90/m (SC).

This plough and carriage were supposed to produce a furrow of 30 cm, the ridge being returned by a board to the furrow, in an inverted position, to give a smooth unridged surface. It was known from earlier work that this plough was not working well, returning only about 20 % of the ridge. There were two discs forward so the vegetation was cut cleanly, leaving no hinge. It was first tried in the trial area with a left hand throw draining bucket. The board failed, even after adjustment, to return the ridge to the furrow, merely shaving off the top. The draining bucket was replaced by a L/H tine head, achieving better results - about 5-10 % of the ridge was returned. Problems also arose in accurate setting of the discs relative to the mouldboard, and in some clogging of the spoil under the beam, Modifications of the board were discussed with the mechanics, but not done. It was impossible to adjust the board suitably for height and angle to do a successful job. It was thought to be too brutal and unsympathetic a shape, and something more curved was needed to keep the ridge under control all the time until depositing it back in the furrow. Photo CS 3 shows the mounting points for the 2 discs, and CS 4 shows the mounting at the extreme end of the beam for the return board (at work in a CS plot - not during the SC treatment).

It was therefore decided to abandon a mechanical replacement system, and replace the ridge by hand. For this a Fiat 80 tractor with a mounted beam, was brought in. The L/H tine head was fitted, and the disc reversed on its shaft, to give the detached ridge, as the tine ran in the rip channel. The Fiat was brought in as a small mounted plough was much handier in the confined spaces, and it allowed the D6 to keep going with the RS treatments.

Subsequent hand replacement was not easy, or particularly satisfactory, a main reason being the crumbly nature of this mineral soil - much of it was left among the heather and not returned. This was thought to be a major cause of the failure of the trailed carriage and return board - the ridge was unwilling to stick together. In a more cohesive soil the replacement may well be better. The principle seems excellent from many points of view, particularly cultivation, and future operations over the ground, though rapid heather re invasion is anticipated. A specifically designed plough, preferably mounted, would be welcome.

CHB. 11/80.

FORESTRY COMMISSION
R&D DIVISION
SUMMARY EXPERIMENTAL RECORD

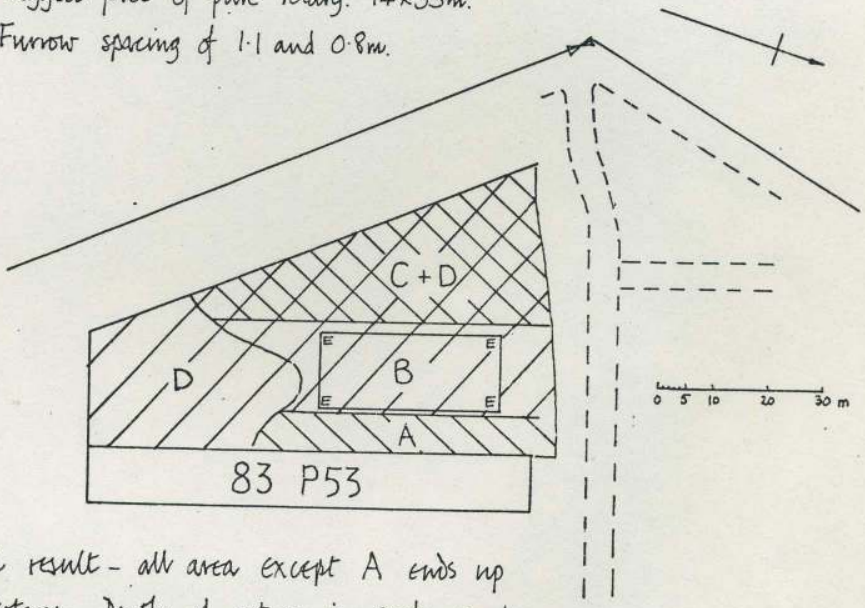
Section SILV(N)
Form 11A

Compt No: 37 ORTON AREA Forest/Expt: (SPEYMOUTH) TEINDLAND III P80

Grid ref: NJ 283539 Series and Sheet No: 1ST SERIES 1:50 000 SHEET 28

Plough Trial Area for Teindland III P80

A. 'Centripetal' plough with draining bucket.
B. Rotary plough trial area.
C. 'Centripetal' trial with LH time head, with & without ripping.
D. Rotary ploughed to fill up site
E. Pegged plot of pure rotary. 14×33m.
Furrow spacing of 1·1 and 0·8m.



Final result - all area except A ends up as rotary. Depth of rotary is such as to completely disrupt the centripetal ploughing in 'C', but will not disrupt the ripping.

Planted 16·5·80 with SS 70(711) lot 8, 2+1, ex Newton (Research) @ 2×2m
Fertilized 31·7·80 with URP @ 375 kg/ha (50 kg P/ha) applied broadcast.

CHB. 11/80

Sheet No (iv)

FORESTRY COMMISSION
R&D DIVISION
SUMMARY EXPERIMENTAL RECORD

Section Silv (N)

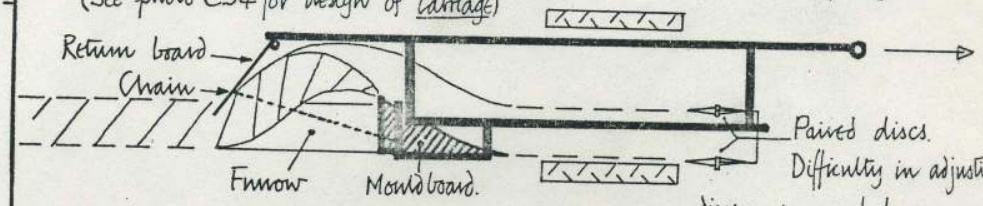
Form 11A

Compt No: 108 Forest/Expt: (Speymouth) TEINDLAND 111 P80

Grid ref: NJ 282536 Series and Sheet No: 1st Series 1:50 000 Sheet 28

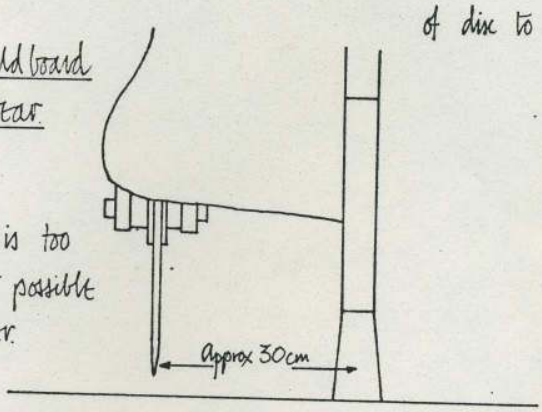
'SC' TREATMENT

1. Theoretical action of 'Centripetal' or 'Replacement' plough.
(See photo CS4 for design of carriage)



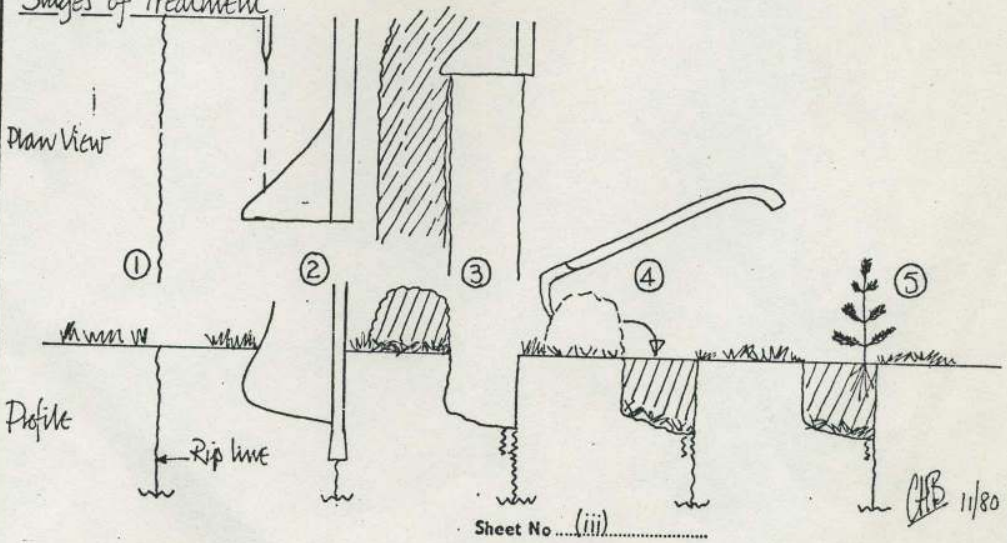
Difficulty in adjusting discs was caused by proximity of disc to main wheel.

2. View of mould board and disc, from rear.
See photo SC 4.



At 30cms the gap is too narrow, but it was not possible to move the disc further.

3. Stages of Treatment



CJB 11/80

Sheet No (iii)

FORESTRY COMMISSION
R&D DIVISION
SUMMARY EXPERIMENTAL RECORD

Section SILV.(N)

Form 118

Forest/Expt: (SPEYMOUTH) TEINDLAND 111 P.80

Date	Summary of Reports and Assessments								
	Treat. +(plot)	Block	Depth (cm)		Time (hrs)		Survival %		
			Ripping	Ploughing	Ripping	Ploughing	9/80	1/82	
3/80, 9/80	RS	(1) I	77.3	62.7	2.0	7.50	99.5	100.0	
		(7) II	81,4	59.5	2.0	8.50	97.7	99.0	
		(13) III	81.9	65.3	2.0	8.50	96.0	99.7	
		(16) IV	83.2	64.8	2.0	8.75	97.5	99.7	
			80.95	63.08	2.0	8.31	97.66	99.6	
	CD	(5) I		82.2		3.75	97.5	99.7	
		(8) II		74.8		3.50	87.9	99.0	
		(11) III		76.0		6.00	98.2	99.7	
		(18) IV		74.6		4.50	92.2	99.5	
				76.90		4.44	93.94	99.5	
	CS	(3) I	84.6	57.2	2.0	3.00	97.2	100.0	
		(10) II	79.6	53.7	2.0	3.25	91.9	99.5	
		(15) III	82.5	56.4	2.0	4.25	93.9	99.7	
		(19) IV	80.4	54.3	2.0	4.00	96.0	100.0	
			81.78	55.40	2.0	3.63	94.76	99.8	
	SD	(4) I		81.0		1.50	92.2	99.5	
		(6) II		75.7		2.00	94.7	99.7	
		(12) III		72.0		1.25	84.6	100.0	
		(20) IV		67.9		1.50	89.9	99.5	
				74.15		1.56	90.34	99.7	
	SC	(2) I	79.1	49.5	2.0	2.50	82.8	100.0	
		(9) II	78.6	51.2	2.0	2.50	84.3	99.5	
		(14) III	82.5	50.4	2.0	2.50	83.6	99.7	
		(17) IV	81.7	51.0	2.0	2.50	89.9	98.7	
			80.48	50.53	2.0	2.50	85.16	99.5	

10/80 Considerable ponding of water over expt., particularly end of SD furrows and edges of RS plots. Steady flow along rip line of SC plots. Without considerable draining the effects of the plough treatments on water levels may be made unrealistic, the effect being exaggerated by the small size of the plots.

3/81 After heavy rains, area is generally free of water except for some furrow ends. Gulls present.

CHB 1/82

Forest Research

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John Keenlyside
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30th July 2003

Hello John,

Further to our telephone conversation this week,

I have spoken to Alistair MacLeod on his return regarding the Teindland cultivation experiments. The general impression seems to be that although a greater degree of cultivation gave initial increases in growth, the sites with less cultivation eventually catch up.

Additionally, the lack of basic nutrition of the site slows growth to the point where cultivation issues are overtaken by nutritional ones.

I hope the enclosed note makes the points clearer.

Sorry not to be able to go into more detail, but I'm sure NRS would be able to make more information available if you require it.

Yours sincerely,

AKennedy

Andy Kennedy

A.L. Sharpe
Newton.

ALS
JD
AHC
file(s)

DIARY OF J MCNEILL - 27 MAY 1993 with A L Sharpe

Teinland 81 P52 (Cultivation of heathland and species choice)

As this is one of the core experiments, time was taken to inspect the plots fairly intensively whilst on a general visit to the reserve area. This experiment compares the effects of 6 ploughing treatments on pure SP, PC/JL mixture (main plots) and JL in mixture with DF, NS, SS and WH (minor plots). The main plots are probably where the main interest will continue but even so, it is difficult to arrive at any clear thoughts on likely continued work from current visual impressions. It is likely that the cultivation effects have now equalised, a fact borne out by the 36 year BA/volume assessment analysis, and that the future interest will continue with the main species comparisons. Periodic BA assessments could continue in the pure SP and the PC/JL mixture plots but time would have to be spent looking at the current data to ensure that future inputs would be of value. Although of interest historically, can we afford to spend further workload time on this experiment?

J D McNeill
27 May 1993

Teinland 111 P80 (Cultivation and nutrition of SS on mineral heathland)

Although listed as a core experiment candidate, the visual impression of this experiment suggests that the cultivation effects have now been dominated by the nutritional ones and, as pure SS is no longer a realistic option on these sites, the future of this experiment appears rather questionable. The most striking differences showing are mainly between the nitrogen and non-nitrogen treatments, however, the whole experiment is now showing various degrees of N deficiency but the controls are the most severely affected in terms of growth and colour. There is a suggestion that the controls on the CD and SD cultivations are slightly better in places but other than that there are no obvious visual differences. Unless there is a good argument for the continuation of this experiment it might be worthwhile considering closure as we must have other demonstrations of N deficiency on mineral heathland sites. Returning the area to the FE would involve quite an amount of work as the control plots would have to receive either heather control and/or nitrogen to improve growth and colour. The surrounding FE buffer zone has received heather control but the colour improvement is already fading and nitrogen is now required to maintain the benefit.

J D McNeill
27 May 1993

JDMCN16.WIN/3

FORESTRY COMMISSION RESEARCH DIVISION

SILVICULTURE (NORTH) BRANCH

AMENDED EXPERIMENT PLAN

Experiment: Teindland 111 P80.

Project Nos: 538, 539, 375.

ODC Nos: 232.216, 421.2

Preamble: A series of experiments comparing various site preparation techniques on heathland sites has been established over the past 15 years. These experiments (Dornoch 4 P70, Black Isle 4 P70, Wykeham 116 P72 and Teindland 102 P69) are concerned mainly with general comparisons of tree growth on different ploughing intensities. It is now believed that tree growth responses to cultivation on hard Calluna heathlands are strongly influenced by nitrogen nutrition, particularly the rates of nitrogen mobilization and depletion, associated with changes in soil physical conditions under different site preparation treatments. It is also clear that longer term stand stability is influenced by site preparation, with spaced furrow ploughing producing severe restrictions on the spread of structural rooting. It is important to compare both tree growth and associated root development on several site preparation treatments which provide contrasting nutritional conditions and influences on root spread.

The original experiment plan provided for a more complex design with very small split plot sizes and limited opportunity to carry out basal area assessments later in the rotation. This revised plan simplifies and improves the design, to cover only 2 contrasting nutritional levels (by combining 2 of 3 split plots proposed originally), and gives plots which can be monitored, by basal area assessment, to full rotation.

Objects: 1. To compare tree growth and root development on 5 site preparation treatments.

2. To investigate the effects of interrow cultivation on juvenile growth and root development on the 5 site preparation treatments.

3. To compare juvenile tree growth on the 5 site preparation treatments at 2 contrasting levels of nitrogen nutrition.

Species: Sitka spruce (Picea sitchensis).

Experimental treatments: 1. Site Preparation

RS - Rotary Mouldboard Ploughing. Complete ploughing, furrows approx 0.8 m apart.
CD - Deep Tine Ploughing. Complete ploughing, furrows approx 1 m apart.
CS - Shallow Tine Ploughing + Deep Ripping. Complete ploughing, furrows approx 0.6 m apart.
SD - Deep Tine Ploughing. Spaced furrow ploughing @ 2 m and 3 m.
SC - Ridge Replacement Ploughing + Deep Ripping. Spaced furrow @ 2 m and 3 m.

2. Interrow Cultivation

IR - Interrow cultivation in one of the 3 x 2 m split plots per mean plot at years 3 and 5.
NIR - No interrow in the remaining 2 x 2 m and 3 x 2 m split plots in each main plot.

To facilitate interrow cultivation 2 spacings are necessary:-

1 - 2 x 2 m planting distance (with no interrow cultivation)
2 - 3 x 2 m planting distance (with and without interrow cultivation).

3. Nutrition

NH - Calluna control by herbicide plus nitrogen fertiliser as a general treatment to ⅔ of the main plots.
O - No Calluna control or fertiliser input to the remaining ⅓ of each main plot.

Design: A criss-cross design for the nutrition and interrow cultivation treatments, superimposed on 4 randomised blocks of the 5 site preparation treatments.

Statistical analysis: See appendix.

Plot sequence: See IW's note of 21 May 1986.

Plot size:
1. Each main plot to be 56 x 36 m (0.2016 ha).
2. First level split plot size (spacing/interrow cultivation) to be 18 x 36 m (0.0648 ha).
3. Second level split plot sizes (NH and O) to be 56 x 24 m (0.1344 ha) and 56 x 12 m (0.0672 ha) respectively.
4. Assessment plots to give maximum number of trees within each split plot, leaving a single row surround.

Basic treatments:
1. Fertilisers: 50 kg ha^{-1} P at planting broadcast as URP.
2. Fencing: The experiment area is ringfenced to exclude deer and stock.
3. Planting: Notch planting in raised positions in spring 1980.
4. Herbicides: Glyphosate at standard rate in spring or 24-D at standard rate in late summer to control Calluna.
5. Fertiliser: Nitrogen as Urea to be applied to all plots, following effective Calluna control, between years 5-8, or as indicated by foliar analysis.

Requirements:
1. Area: 4.8 ha uniform Calluna dominant heathland with indurated/iron pan soil. (4.03 ha net).

2. Plant: Caterpillar D6 for Rotary Mouldboard, CS and SC treatments, and Caterpillar D7 tractors for CD and SD treatments.

Ploughs - a. Rotary Mouldboard Plough (RS60/T90/m). D6.
b. Deep Tine Plough (S60/T90/m). D7.
c. Shallow Plough (S30/-/m). D6.
d. Deep Ripper (T90/m). D7.
e. Medium Tine Plough (S45/T60). D6.

Tractor for inter-row cultivation - 4 wheel drive tractor (hired machine) SAME Jaguar 100 pulling a heavy 'Kongsklide' cultivator 4 tines in 1.7 width.

Records and assessments:

1. Survival - After 1st and 2nd growing season) Map form assessment
2. Height - Years 3, 4, 6, 10, 15.)

3. Basal Area - Every 5 years, commencing year 15.

4. Foliar sampling - Initially at year 4, then as indicated by condition.

5. Root Development - Tree pulling/root excavation between 8-10 years.

The following ERF's are to be maintained:-

1, 2, 3, 4, 11a, 11b, 11c and 11d.

Duration: Full rotation.

Amended plan drafted by: K F Miller Silviculturist (North)
30 May 1986

Design approved by: I M S White Statistician
6 June 1986

Approved: Alan J Low P Silv(N)
12 June 1986

Distribution:

Project Files 538, 539 & 375	3
Experiment File Teindland 111 P80	1
Research C/F J C Keenleyside, Newton	1
Research H/F A A Green, Newton	2
Project Leader K F Miller, NRS	1
Conservator N(S) Mr J Atterson, Inverness	1
FDM Mr K Buswell, Speyside FD	1
Spares	2
Total	12

KFM/MRW