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Mine Waste Reclamation Ltd.
Guelph, Ontario: Mine Waste Reclamation Ltd., June 1982

A PRELIMINARY STUDY OF REQUIREMENTS FOR PLANT GROWTH ON SOILS FROM THE CRANDON PROJECT AREA

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JUNE 1982

SUBMITTED TO EXXON MINERALS COMPANY,
CRANDON PROJECT, RHINELANDER, WISCONSIN.

1.0 INTRODUCTION

A preliminary study of the requirements for plant growth on sub-soil material from the Crandon Project site was undertaken by Mine Waste Reclamation Ltd. The study was limited to one sample obtained during earlier geotechnical investigations. The main objective was to determine if Crandon Project area sub-soils contained any serious impediments to plant growth. The extremely limited nature of the investigation was recognized at the outset. Hence the result of the study was to be considered indicative only and not to provide a definitive answer.

2.0 MATERIALS AND METHODS

2.1 Sample source

The sub-soil sample used in the study was originally obtained from the Crandon Project area, test pit No. 22, adjacent to boring G41-P24 (Table 1). It had been studied by Golder Associates as part of the geotechnical investigation being undertaken by them.

- sample size

2.2 Sample treatment

At Guelph, the contents of each container were passed through an horticultural sieve to remove soil fractions larger than one inch diameter. Each container contents were then mixed to ensure uniformity. An approximately one-pound

sub-sample was taken from each container and submitted to the Soil Testing Laboratory, Ontario Ministry of Agriculture and Food for a standard agricultural soil test analysis (pH, total salts, phosphorous, potassium, calcium and magnesium).

It must be emphasized that such tests have been developed for normal agricultural soils in Ontario having well defined characteristics and that the analytical techniques used are not necessarily suited to sub-soil and non-soil materials lacking these characteristics. Hence the soil test data obtained must be interpreted with caution and considered indicative only, not absolute.

The two samples were placed in plastic containers 6" x 2.5" diameter. Selected rates of agricultural limestone were added and mixed in with the sample materials. The procedure was repeated for fertilizer addition. The agricultural limestone used was a dolomitic type, having a neutralizing value of 100 per cent and an agricultural index measuring 56. Commerical agricultural fertilizers were used, which had previously been ground in order to achieve a uniform distribution throughout the sample materials (Table 2).

The F2 fertilizer treatment is representative of a standard formula used by the Ontario Ministry of Transportation and

Communications when seeding after highway construction. The F3 fertilizer treatment was selected for use on the basis of experience gained by Mine Waste Reclamation Ltd. when seeding soils exposed during construction activity.

After mixing of agricultural limestone and fertilizer, the contents of each plastic container was equally split between three smaller plastic containers. Three seeds mixtures were used to assess plant growth on the non-amended and amended sub-soil samples; birdsfoot trefoil + creeping red fescue, crown-vetch + creeping red fescue, and an all-grass mixture (Table 2). Following seeding of the two legume-grass mixtures the sub-soil surfaces were dusted with commercial legume inoculant. All three seeds mixtures were then mulched using a proprietary straw-cotton-paper based mulch. Both birdsfoot trefoil and crown-vetch were seeded at rates equivalent to 22.4 kg/ha (20 lb/ac), creeping red fescue at 34 kg/ha (30 lb/ac) and the all-grass mixture at 90 kg/ha (80 lb/ac).

The containers were divided into three blocks, each block containing one container of each sample x every treatment combination. The three blocks were placed in an environmentally-controlled growth room having a 12-hr. photoperiod, ambient temperature 72 $\pm$ 5^{o}F, relative humidity 60 $\pm$ 5 per cent. Containers were watered once every 48 hours by watering from above with a conventional garden hose attachment.

At harvest time, (54 days after seeding), plant material was clipped at soil level, dried, weighed and an appropriate table constructed.

3.0 RESULTS

3.1 Soil Testing analysis

Both sub-soil samples exhibited a moderately acid reaction (Table 3). The total salts value for either sample was extremely low. According to soil test interpretative values developed for Ontario, the sub-soil(s) showed medium requirements for phosphorous fertilization with a phosphate requirement of 20 kg/ha P_2O_5 (18 lb/ac). Similarly interpreted, the sub-soil was low in potassium and would require fertilization with 80 kg/ha potash (71 lb/ac). The values obtained for magnesium and calcium indicated neither a deficiency or an excess present.

3.2 Plant growth

Acceptable levels of plant growth were obtained on the two sub-soil samples where birdsfoot trefoil-creeping red fescue and crownvetch-creeping red fescue were seeded; growth of the all grass seeds mixture was poor and it showed typical symptoms of nitrogen deficiency. There was no advantage to correcting the moderately acid reaction of the samples by adding agricultural limestone (Table 4).

Both legume-based seeds mixtures responded to the addition of fertilizer. However, no practically significant differences were obtained between the fertilizer treatment of 448 kg/ha 5-20-20 and that of 841 kg/ha 5-20-20 + 560 kg/ha 0-46-0. On sample 1 there was a response of the all grass seeds mixture between no fertilizer and the lesser fertilizer treatment (F2) but not between the no fertilizer and larger fertilizer application (F3).

There was a definite pattern across all treatments for plant growth to be less on sub-soil sample 2 than on sub-soil sample 1. No satisfactory explanation can be offered for this unexpected discrepancy; unexpected in the fact that both samples were sub-samples of one larger sample.

The greater dry weight of the birdsfoot trefoil-creeping red fescue mixture over that of the crownvetch-creeping red fescue mixture should not necessarily be taken as an indication of superiority of the former. The difference in plant dry weight is a reflection of the known lower seedling vigour and growth rate of crownvetch compared to that of birdsfoot trefoil. Crown-vetch seedlings were healthy and exhibited no symptoms of nutrient deficiency or disease on either sub-soil sample. However, there were fewer seedlings per replicate (visual observation) which again is reflective of the lower germination rate of crownvetch compared to that of birdsfoot trefoil.

The plant growth data obtained here should not be used solely as the basis for seeds mixture selection for subsequent field seedings. Other factors such as required end-use of areas seeded in the field must also be taken into consideration.

TABLE 1

Origin of Soil Sample

Sample Material:	Data from container label
	Crandon project area, test pit No. 22, adjacent to boring G41-P24.
	Collector's sample No. GT-1, sampled March 15, 1981.
Sample source:	Golder Associates, 3151 Wharton Way, Mississauga, Ont.
	Sub-samples from main container (2 x 5-gal. pails) collected by E. M. Watkin, Mine Waste Reclamation Ltd., December 29, 1981.
Sub-sample identification:	Two sub-samples were labelled 1 and 2 (random) and both used as separate samples in plant growth test.

TABLE 2

1. Treatment of Sample:

Main treatment: Agricultural limestone applied at 0 and 5.6 tonnes/ha (0 and 2.5 tons/acre).

Sub-treatments:

F1 No fertilizer added

F2 5-20-20 @ 448 kg/ha (400 lb/ac)

F3 5-20-20 @ 841 kg/ha (400 lb/ac) + 0-46-0 @ 560 kg/ha(500 lb/ac)

2. Species assay mixtures:

Seeds mixture:

S1 - Birdsfoot trefoil cv. Leo and Creeping red fescue cv. Reptans.

S2 - Crownvetch cv. Penngift and Creeping red fescue cv. Reptans.

S3 - Pickseed "low maintenance" mixture; a commercially produced blend of various grasses only and in which exact details of component species, varieties thereof, and proportions thereof, is not public information.

3. Replication:

Each sample x agricultural limestone x fertilizer treatment x species mixture combination was replicated three times.

4. Seeding date: February 2, 1982; Harvest date: March 30, 1982.

TABLE 2 (cont'd)

Treatment Number Identification

Sample No. 1	Fertilizer treatment	Trefoil red fescue		Crownvetch red fescue		All grass mixture	
		Agricultural limestone t/ha*					
		0	5.6	0	5.6	0	5.6
	F1	1-3	4-6	19-21	22-24	37-39	40-42
	F2	7-9	10-12	25-27	28-30	43-45	46-48
	F3	13-15	16-18	31-33	34-36	49-51	52-54
Sample No. 2	F1	55-57	58-60	73-75	76-78	91-93	94-96
	F2	61-63	64-66	79-81	82-84	97-99	100-102
	F3	67-69	70-72	85-87	88-90	103-105	106-108

*tonnes per hectare

TABLE 3

Soil Test Values for Sub Soil Samples from Crandon Project Site

	pH	Total Salts micromhos/cm	Phosphorous ppm	Potassium ppm	Magnesium ppm	Calcium ppm
Sample 1	6.2	100	12	60	144	725
Sample 2	5.9	100	12	50	139	700

Notes:

1. Analysis by Soil Testing Laboratory, Ontario Ministry of Agriculture and Food, Guelph, Canada.
2. pH by paste technique.
3. Available phosphorous by 0.5N sodium bicarbonate extraction.
4. Available potassium by 1N ammonium acetate extraction.
5. Total calcium and magnesium by A.A.

TABLE 4

Plant growth on soil sample from Test Pit No. 22 from proposed tailings area - Crandon Project
Average grams dry weight of three replicates after 56 days

Sample	Fertilizer treatment	Trefoil Red fescue		Crownvetch Red fescue		All grass mixture	
		Agricultural limestone t/ha*					
		0	5.6	0	5.6	0	5.6
Sample 1	F1 None	0.71	0.66	0.35	0.35	0.27	0.29
	F2 5-20-20 @ 448 kg/ha	0.88	0.86	0.48	0.49	0.36	0.36
	F3 5-20-20 @ 841 kg/ha +0-46-0 @ 560 kg/ha	0.84	0.88	0.44	0.39	0.27	0.31
	Ave.	0.81	0.80	0.42	0.41	0.30	0.32
Sample 2	F1 None	0.42	0.50	0.23	0.24	0.24	0.29
	F2 5-20-20 @ 448 kg/ha	0.72	0.85	0.32	0.33	0.26	0.32
	F3 5-20-20 @ 841 kg/ha +0-46-0 @ 560 kg/ha	0.93	0.84	0.35	0.31	0.28	0.20
	Ave.	0.69	0.73	0.30	0.29	0.26	0.27

*tonnes per hectare