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THE EFFECT OF GYPSUM ON THE CHEMICAL AND PHYSICAL  
PROPERTIES OF A RANGE OF RED BROWN EARTHS

Thesis submitted by

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## CONTENTS

	<u>Page</u>
SUMMARY	i
STATEMENT	iv
ACKNOWLEDGEMENTS	v
CHAPTER 1. Introduction	1
CHAPTER 2. Literature Review	2
2.1 Definitions	2
2.2 Clay Water Interaction	5
2.2.1 Adsorption of water - swelling	5
2.2.2 Effect of electrolyte concentration	8
2.2.3 Effect of cation valency	10
2.2.4 Monovalent and divalent Systems	12
2.3 Stabilizing Forces	13
2.3.1 Organic Matter	13
2.3.2 Electrostatic attraction	14
2.3.3 Madelung forces	14
2.3.4 Iron and Aluminium Oxides and Hydroxides	15
2.4 Effect of Different Cations on the Soils Physical Properties	16
2.5 Amendments used to displace exchangeable sodium	18
2.6 Effect of Gypsum on Soil Physical Properties in Australia	19
2.6.1 New South Wales	19
2.6.2 Victoria	21
2.6.3 Western Australia	22
2.6.4 South Australia	22
2.7 Summary	23

	<u>Page</u>
CHAPTER 3. Methods	24
3.1 Mechanical Properties	24
3.2 Chemical Properties	24
3.2.1 Total Soluble Salts and pH	24
3.2.2 Calcium Carbonate	24
3.2.3 Organic Carbon	25
3.2.4 Cation Exchange measurements	25
3.3 Physical Properties	27
3.3.1 Bulk Density and Soil Water Content	27
3.3.2 Aggregate Cohesion	28
3.3.3 Aggregate Stability	28
3.3.4 Rainfall Simulation	31
3.3.5 Crust Shearing Strength	39
CHAPTER 4. Initial Survey	40
4.1 Experimental	40
4.1.1 Soils	40
4.1.2 Sampling	40
4.1.3 Analysis	41
4.2 Results and Discussion	42
4.2.1 Relation between individual soil tests and properties	42
4.2.2 Effects of Interactions of soil properties on physical tests	49
4.2.2.1 Aggregate Stability	50
4.2.2.2 Cohesion	50
4.2.2.3 Bulk Density	50
4.3 Comparison with other work	51

	<u>Page</u>
CHAPTER 5. Field Experiments	53
5.1 Experimental	53
5.2 Sampling	54
5.2.1 Soils	54
5.2.2 Herbage	55
5.3 Analysis	55
5.3.1 Mechanical Analysis	55
5.3.2 Chemical Analysis	55
5.3.3 Physical Analysis	55
5.4 Results and Discussion	56
5.4.1 Effects of Gypsum on Soil Chemical Properties	56
5.4.1.1 pH	56
5.4.1.2 Total Soluble Salts	58
5.4.1.3 Organic Carbon	59
5.4.1.4 Exchangeable Cations	59
5.4.1.5 Soluble Salts	65
5.4.2 Effect of Gypsum on Soil Physical Properties	65
5.4.2.1 Aggregate Stability	65
5.4.2.2 Rainfall Simulation and Moisture Content	68
5.4.2.3 Dry shearing strength	71
5.4.2.4 Bulk Density	71
5.4.3 Effect of Gypsum on Dry Matter	71
5.5 Conclusions	73

	<u>Page</u>
CHAPTER 6. Field Test	77
6.1 Experimental	77
6.2 Method	77
6.2.1 Calculation of the Dispersion Index (DI)	79
6.3 Results and Discussion	79
6.4 Comparison with other work	81
CHAPTER 7. Conclusions	84
CHAPTER 8. Bibliography	87
APPENDICES A.	
B.	

## LIST OF TABLES

	Page
1	The thickness of the double layer of Clays saturated with monovalent cations in a solution of 1:1 electrolyte of various matric potentials. 9
2	Rainfall intensity for different apertures, water pressures and nozzle sizes. 35
3	Uniformity coefficient for different apertures water pressures and nozzle sizes. 36
4	Median drop diameter for different apertures, water pressures and nozzle sizes 37
5	Summary of results of Physical tests and Chemical Analyses for 28 sites 41
6	The significance of coefficients between physical tests. 44
7	The significance of coefficients between chemical and mechanical properties. 44
8	The significance of coefficients between physical tests on soils and their mechanical and chemical properties. 45
9	Coefficients of linear regression of chemical and mechanical properties on results of physical tests. 47

		<u>Page</u>
10	Effect of percentage of organic carbon on physical tests.	48
11	Effects of exchangeable sodium percentage on physical tests.	48
12	Soil site numbers in relation to ESP range and EMgP range	53
13	Analysis of the seed gypsum used.	54
14	Effect of different gypsum application rates on the exchangeable sodium percentage to a depth of 30cm by <u>1973</u> (18 months after application).	60
15	Effect of different gypsum application rates on the exchangeable sodium percentage to a depth of 30cm by <u>1974</u> (30 months after application).	61
16	Effect of different gypsum application rates on the exchangeable magnesium percentage to a depth of 30cm by <u>1973</u> (18 months after application).	63
17	Effect of different gypsum application rates on the exchangeable magnesium percentage to a depth of 30cm by <u>1974</u> (30 months after application).	64



		Page
18	Aggregate stability (mm) for sites showing response in 1973 to gypsum addition (18 months previously)	66
19	Effect of gypsum on aggregate stability in 1974 in the Soil Profile 30 months after application (responsive sites only).	67
20	Effect of gypsum treatment on the total amount of run-off from rainfall simulation (responsive sites only).	69
21	Effect of gypsum treatment on water content in the soil profile (responsive sites only)	70
22	Effect of gypsum treatment on the dry shearing strength of the soil crust (for responsive sites only) 1973-74.	72
23	The response to gypsum application at the field sites.	74
24	The effect of different gypsum application rates on the responses to specific tests for the different field sites.	75
25	Values for the Dispersion Index (DI) for each site, calculated from the ranked dispersion at the air dry and remoulded (100cm suction) stages.	80
26	Values for 'Loveday's' regression equations to predict penetrometer resistance and seedling emergence for sites 1 to 10.	82

## LIST OF FIGURES

	<u>Page</u>	
1	Structure of the lamellae of a 1:1 layer clay mineral (kaolinite) and a 2:1 layer clay mineral (montmorillonite) from Hillel (1971)	3
2	The difference in concentration of the positive and negative ions in solution from the surface of a clay lamella bearing net negative charge. $N_0$ is the Ionic concentration in the bulk solution (Hillel 1971)	7
		<u>After page</u>
3	Schematic diagram of Spray Unit	33
4	Map of the Mid and Lower North regions of South Australia showing the location of the survey sampling sites.	41
5	Relation of exchangeable sodium percentage to aggregate stability in red-brown earths	49
6	Map of the Mid and Lower North regions of South Australia showing location of Field Experimental Sites.	53
7	Layout of Gypsum Field Trials	54
8	Effect of the Addition of Gypsum on pH in the soil profile by 1973 (18 months after application)	56

- |    |   |    |
|----|---|----|
| 9  | Effect of the Addition of Gypsum on pH in the soil profile by 1973 (18 months after application). | 56 |
| 10 | Effect of the Addition of Gypsum on pH in the soil profile by 1974 (30 months after application). | 56 |
| 11 | Effect of the Addition of Gypsum on pH in the Soil Profile by 1974 (30 months after application). | 56 |
| 12 | Effect of Gypsum on Dry Matter Yield.   | 72 |

SUMMARY

Application of gypsum has long been recommended for red-brown earths with structural problems. However, results obtained in South Australia have proved inconclusive indicating the need to define the structural problems more clearly before recommending the use of gypsum.

A survey was conducted throughout the Mid and Lower North regions of South Australia to select and sample red-brown earths with surface structural problems. Samples were taken from 28 sites for chemical and physical analysis to determine factors responsible for the physical conditions of the soils.

Aggregate stability was found to be related to organic carbon content and exchangeable sodium and magnesium percentages by the following equation:

$$\text{Aggregate stability} = 0.82 + 2.13 \text{ organic carbon} - \\ (0.6 \text{ ESP} + 0.3 \text{ EMgP})$$

Sites with a history of regular harrowing had soils with lower aggregate stability and higher aggregate cohesion than soils from sites not subjected to harrowing.

It was deduced that a structure improvement programme for the hard setting red-brown earths should be aimed at reduction in harrowing, improved management techniques to increase the organic carbon level, addition of gypsum to reduce the exchangeable sodium percentage (ESP)

and exchangeable magnesium percentage (EMgP) or a combination of them all.

To enable decisions to be made regarding which hard setting red-brown earths would be improved by gypsum application ten field trial sites were used. The trials were carried out on a range of hard setting red-brown earths with ESP ranging from greater than 17.5 to less than 5 and EMgP from greater than 20 to below 13. Gypsum rates of 0, 2.5, 5 and 12.5 t/ha were applied in March 1972 and the physical and chemical changes resulting from these applications were examined in October 1973 and October 1974. Structural measurements included crust shearing strength and the use of a portable rainfall simulator for examining changes in rainfall run-off.

Gypsum application resulted in reductions in soil pH, ESP and EMgP, the amount and depth to which these reductions occurred depending on the rate of gypsum applied. Gypsum application was also found to improve rainfall run-off in 4 sites in 1973 and 3 sites in 1974 and reduce crust shearing strength at 3 sites in 1973 and 1974. Dry matter yield increases from 580 kg/ha to 1660 kg/ha were also obtained and attributed to improved water penetration and reduced crust strength.

From these results it was predicted that hard setting red-brown earths with ESP above 17.5 would give both structural and yield responses to applied gypsum and red-brown earths with moderate ESP (5-10) and EMgP values

greater than 20 would show improved structure after addition of gypsum.

Because determination of ESP and EMgP requires laboratory work a field test was evaluated on the basis of being able to distinguish which soils would give yield and/or structural responses to gypsum application. The field test based on dispersion of air dried aggregates in water, selected sites with high ESP values but showed poor agreement with the results from the field trials.

It was concluded that gypsum application should not be regarded as a panacea for all surface structural problems of red-brown earths, and that ESP and EMgP values should be used to predict those sites which would benefit from gypsum application.

STATEMENT

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University and, to the best of my knowledge and belief, it contains no material previously published or written by another person, except when due reference is made in the text.

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