DEPARTMENT OF AGRICULTURE, VICTORIA
DIVISION OF AGRICULTURAL CHEMISTRY

SOUTHERN WIMMERA SOILS AND THEIR SIGNIFICANCE TO LOCAL AGRICULTURE

BY

NABIL S BADAWY
SOILS OFFICER

NATIONAL LIBRARY OF AUSTRALIA

CATALOGUING-IN-PUBLICATION DATA

Badawy, N.S. (Nabil Sayed), 1942 –
Southern Wimmera soils and their significance to local agriculture.

ISBN 0 7241 8113 X

1. Soils – Victoria – Wimmera.
2. Land use, Rural – Victoria – Wimmera
I. Victoria. Dept. of Agriculture.
II. Title. (Series: Technical report series (Victoria Dept. of Agriculture); no. 45).

631.4’7’9458

CONTENTS

LIST OF FIGURES

APPENDICES

PREFACE

The information included in this report was presented by the author at a "Minium Tillage" symposium held in April, 1981 at Horsham and organised by the Horsham District Office of the Department of agriculture.

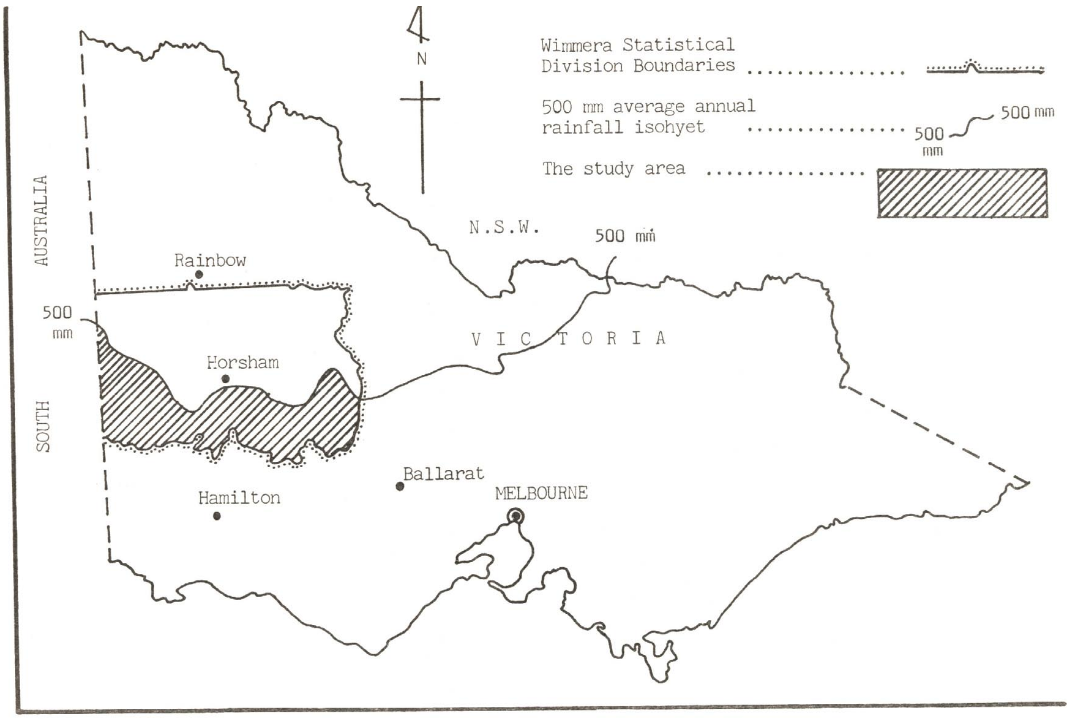
The overall object of the symposium was to shed more light on the minium tillage technique and assess its suitability as a cropping tool in t he high rainfall districts. The immediate concern, however, was to discuss the potentiality of cropping, in general, in the high rainfall zone of Western Victoria. Participants included departmental research and extension officers, chemical companies' representatives and local farmers They discussed environmental and technical aspects related to the meeting's subject matter. A reference to the soils of the area concerned was considered valuable to the theme of the symposium.

ACKNOWLEDGEMENT

The assistance of Mr J J Martin Division of Agricultural Chemistry in the preparation of this report is gratefully acknowledged.

Thanks are also due to Miss C Lawson for her assistance in the preparation of the Overhead Transparencies presented at the symposium and for typing this report.

Figure 1 Locality Plan



INTRODUCTION

Area And Location

This discussion concerns an area of about one million hectares located in the southern half of the Wimmera District, Western Victoria. The area extends between the 500 mm average annual rainfall line, the South Australia/Victoria border and the southern and eastern boundaries of the Wimmera District (Figure 1).

The Main soils

Although a wide range of soil types exists in the study area, only the four main soils, listed below are discussed in this report.

1. Wimmera Grey Self-mulching Cracking Clay (Ug5.2)
2. Bleached Sands (Uc 2)
3. Sandy Pedal Mottled-Yellow Duplex Soils (Dy 5.4)
4. Hard Pedal Mottled-Yellow Duplex Soils (Dy 3.4)

The four soils differ markedly in their characteristics, productivities and agricultural land use capabilities. In this investigation, each of the soils is discussed with regard to t he following aspects:-

a) Soil morphology; including:

   -a summary list of the soil's main distinguishing features.
   -a general morphological description of the soil.

b) Agricultural significance; discussing those soil properties which may significantly affect cropping, with particular reference to :

   -Soil workability, regarding the ease with which the soil can be worked.
   -Crop establishment, regarding the effect o seedbed condition, and its reaction to wetting and drying, on crop emergence and early growth stages.
   -Crop development, regarding the effect of the soil profile properties on crop performance up to maturity.

c) Occurrence; including:

   -a description of the land form with which the soil is commonly associated.
   -an indication of the distribution of the soil within the study area.

d) Land use; Listing the main current agricultural land use. Definitions of the soil terms used are given in an appendix (see page 17).

SOIL 1 - WIMMERA GREY SELF-MULCHING CRACKING CLAYS (UG 5.2)

1.1 Soil Morphology

1.1.1 Distinguishing Features

- Uniform texture profile, which is clayey (fine texture) throughout.
- The soils crack significantly when dry.
- The surface soils are self-mulching and friable.
- A 2 horizon is absent.
- The soil material exhibits strong blocky structure characterised by dominantly smooth-faced peds throughout the soil profile.
- The dominant soil colour is grey to grey brown. Browner or paler colours may appear in the deep subsoils.
- Gilgai formation is common.
- The soil profile is usually calcareous throughout and the occurrence of high amounts of carbonates at shallower depths is not uncommon.
- Accumulations of salts and gypsum are common in the deep subsoils

1.1.2 Soil Description

These soils have uniform fine-textured (clayey) deep to very deep (>150 cm) profiles.

Surface soil
Grey to grey-brown light to medium clay, strong granular soil aggregates which are self-mulching. Soil consistence is soft(dry)friable to very friable (moist), plastic and sticky (wet). Gradual to clear change to :-

Subsoil
Grey to grey-brown medium to heavy clay, strong fine to medium angular and subangular blocky structure, smooth-faced peds. The soil aggregates are moderately hard to very hard (dry), friable to semi-friable (moist), plastic and sticky (wet).

Commonly, the subsoil changes gradually into paler or browner colours and strong coarse blocky structure with depth.

Streaks of surface soil material are often as 'in-fills', to various depths, in the subsoil.
Soil pH

The soil reaction trend shows increase in pH values down the soil profile. The soils are neutral to alkaline at the surface, becoming strongly alkaline with depth.

Soil inclusions

Low amounts of hard nodules (2-10 mm in size) of carbonates (lime) are usually scattered on the surface. Varying amounts of hard and soft lime occur throughout the soil profile.
Typically, moderate to high concentrations of soluble salts are commonly found in the subsoils below 30-50 cm and varying amounts of gypsum of ten occur as fine crystals in the deep subsoils.

Seasonal Crackling

Seasonal cracking is a prominent characteristic of these clays as they expand and contrast significantly with moisture changes. Upon drying, they develop cracks with a minimum occurrence of one crack, at least 6 mm wide and 30 cm deep, per square metre. Such cracks, however, may not be apparent at the soil surface.

Gilgais

Gilgais (melon-holes…etc.) are a common feature of these soils. The gilgai depressions (troughs) range from 3 to >20 m in diameter, separated by a network of mounds (puffs) 1 to 3 m across. On a continuously cropped land, gilgais become obscured at he surface due to grading, cultivation and seedbed preparation. They reappear, however, when the land is left undisturbed for a number of wetting and drying seasons. The puffs are usually raised up to 30 cm above the ground level and the depressions vary in depth between 5 and 50 cm.

1.2 Agricultural Significance

a) Soil consistence
In the dry to moist stage, most of these grey clays are friable and easy to work. They become very sticky when wet. Non-friable clays, however, occur in some depressions and low lying areas. An increase in soil friability often enhances crop establishment and development.

b) Water infiltration
Heavy rains penetrate deeply down the cracks in dry soils but once the surface wets an swells, further infiltration is very slow. After heavy rains, water lies for long periods in the deeper gilgai depressions.

c) Water holding capacity
Most of the Wimmera clay soils have a high water holding capacity.

d) Aeration

The friable cracking clays are usually better structured soils and well aerated when dry. Upon wetting, these clays expand reducing total soil porosity.

e) Seasonal Cracking

Upon rapid wetting, wide cracks in dry soils assist in rapid subsoil water recharge which may be of crucial value to the survival of plants near wilting. Also, cracks contribute appreciably to soil aeration being the main natural passageways for air in the soil mass.

Some agricultural disadvantages of these cracks, though, include acceleration of soil moisture evaporation, some loss of surface soil material down into the subsoils and hosting pests such as crickets and mice.

f) Gilgais

Amounts of carbonates and salts are usually higher in the gilgai puffs than in the depressions. Levelling of gilgais reduces the thickness of the surface soils on the mounds and sometimes exposes their subsoils to the ground surface.

Such soil variability often significantly affects the land's productivity and complicates its management.

g) Soil Reaction

In spite of the capability of these soils to grow a wide range of plant species, their high alkalinity and t he presence of appreciable concentrations of carbonates at shallow depths reduce the soil's potential to successfully support some crops.

h) Soil Salinity

Flooding at irregular intervals helps in eliminating the upward movement of higher concentrations of subsoil salts. Under irrigation, or more frequent flooding, these clays may develop salinity problems following waterlogging of subsoils by rising water – tables. In low – lying areas, soluble salts often accumulate at shallower depths in amounts harmful to the productivity of some crops and pastures.

i) Plant Nutrients

Generally, these clays have cation exchange capacities, high cation exchange capacities, high calcium and potassium status, and moderate amounts of total nitrogen and low phosphorus contents. The soils mineralise nitrogen readily in cultivated bare fallows and initially produce high yields of crops but the total nitrogen contents diminish rapidly upon cropping. On these soils, legumes, including subterranean clover often respond to the additions of zinc, molybdenum, manganese, sulfur, phosphorus and cereals respond to the additions of phosphorus and zinc.

1.3 Occurrence

The Wimmera friable grey clays commonly occur on gently undulating gilgai plains. With regard to the area studied in this report, these soils are dominant in four locations (Figure 2).

(i) The gently undulating plains north of the Grampians.
(ii) The gently undulating plains west of Kaniva to the South Australia/Victoria border.
(iii) The gently undulating plains south of t he Little Desert extending from west of Natimuk to the South Australia/Victoria border.
(iv) The gently undulating plains north west of Edenhope.

1.4 Land Use

(i) Cropping

The Wimmera friable grey clays are extensively cropping for non irrigated cereals, mainly wheat an barley. They also support many legumes and oilseed crops.

(ii) Grazing

In addition to growing high yielding feed crops, sown pastures are successfully established on these soils.

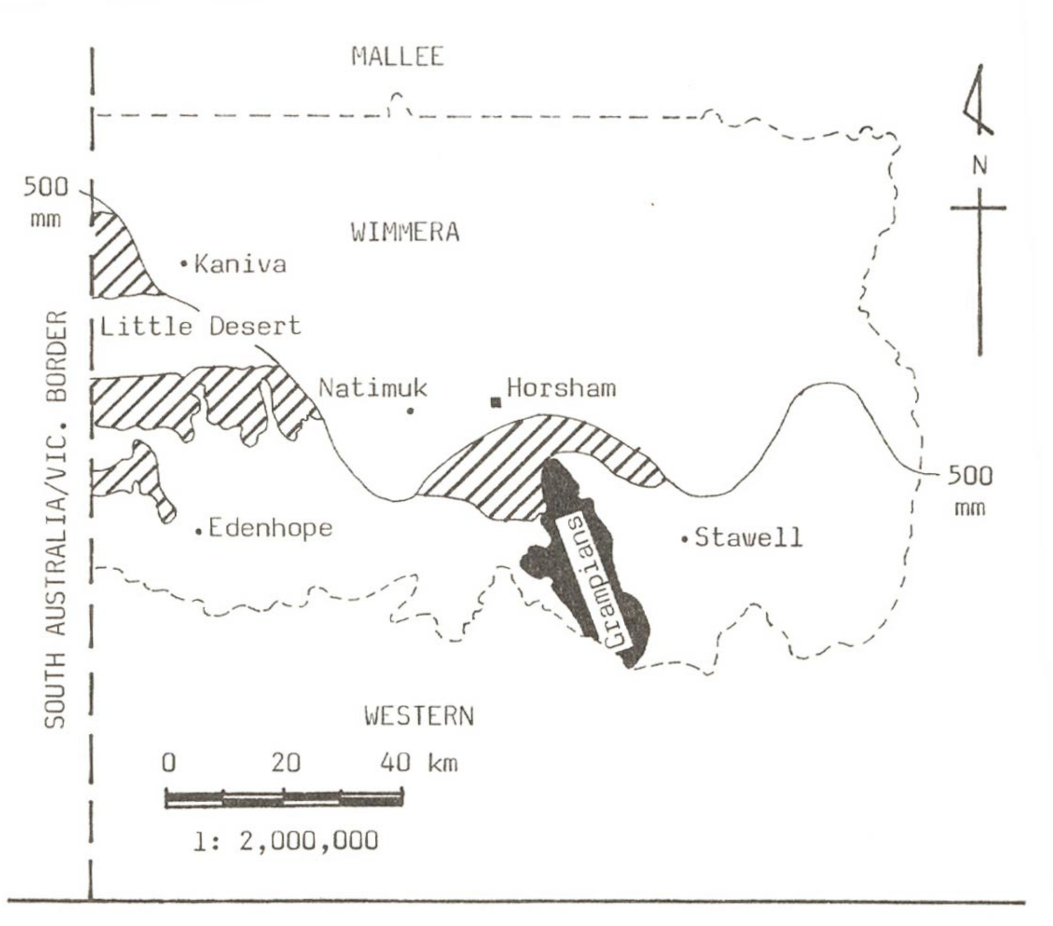


Figure 2 Distribution of the Common Occurrence of soil 1 (Ug 5.2) Within the Study Plan

SOIL 2 - BLEACHED SANDS (UC 2)

2.1 Soil Morphology

2.1.1 Distinguishing Features

- Uniform texture profile, which is sand (coarse-texture) throughout.
- The surface soil ‘A horizon’ is dark, structureless loose sand (single grains).
- A2 horizon is present and strongly bleached. It is thick, non-coherent structureless loose sand (single grains).
- The subsoils ‘B horizons’ are of similar material to those of the A horizons, with differences in :-

  either

  (i) soil colour only; i.e. ‘Colour B Horizons’….Uc 2.2

  and/or

  (ii) degree of compaction; i.e. ‘Hardpan’….Uc2.3

- The ‘Colour B Horizons’ are either whole-coloured or mottled. They vary widely in the main colour and in thickness.
- In soils with cemented B horizons a profile may contain more than one pan. The pans vary widely in colour and in thickness.
- Soil reaction is acid throughout the soil profile.

2.1.2 Soil Description

These soils have uniform coarse-textured profiles which are moderately deep to very deep (1-6 m) strongly bleached sands.

Surface Soil (A Horizons)

<u>A1 horizon:</u>

Brownish grey to very dark grey (almost black) sand to loamy sand, structureless loose (single grains). It ranges from 10 to 80 cm (commonly about 30 cm) thick.

<u>A2 horizon:</u>

Strongly bleached, near white, non0coherent structureless sand, varying in thickness from 10 to 200 cm. In the deeper profiles, this horizon usually comprises more than 50% of the total soil depth.

<u>Subsoil (B horizon)</u>

The subsoil material is similar to that of the surface soils The main morphological differences however, are either in colour (Uc 2.2)or in the degree of compaction Uc2.3).

In the Uc 2.2 soils, the subsoils are referred to as ‘Colour B Horizons”, ranging from 30 to 100 cm thick. These horizons are whole coloured or mottled. Colour and degree of mottling vary widely, they range from yellow-brown to very dark brown or black.

The Uc 2.3 soils are characterised by strongly cemented sand loam B horizons ‘Hardpans’. These pans vary considerably in thickness from 3 to>100cm and in colour from yellow, red to almost black. More than one hardpan, differing in colour, may be found in a soil profile.

Soil pH

The soil reaction is acid throughout the soil profile.

2.2 Agricultural Significance

a) Soil Permeability

Except for the hardpans, these soils are usually highly permeable to water and air and offer low resistance to root penetration. Some surfaces, however,, are difficult to wet when dry.

b) Soil moisture and aeration

Owing to the high content of macro-pores in these soils, their water holding capacity is low and their aeration is high.

In profiles with compacted subsoil horizons, perched water tables of varying durations and at varying depths are usually found following heavy rains.

(c) Erosion

The non-coherent nature of these sands together with their topographical position make them prone to wind and water erosion. The degree of erosion is often increased by the absence of adequate vegetative cover due to fire or overgrazing.

(d) Inherent fertility

As a general rule, the inherent fertility of these leached sands is very low. They are deficient in most of the macro and micro nutrient elements.

2.3 Occurrence

The leached sands occur on the sand dunes and sand hills which are commonly found on the undulating sand plains of the Little Desert and in many localities between the Grampians and the Victoria/South Australia border (Figure 3).

2.4 Land Use

Large areas of these soils have remained undeveloped and provide only sparse grazing on native herbage. Success in cropping or improved pasture establishment depends on heavy fertilizer use.

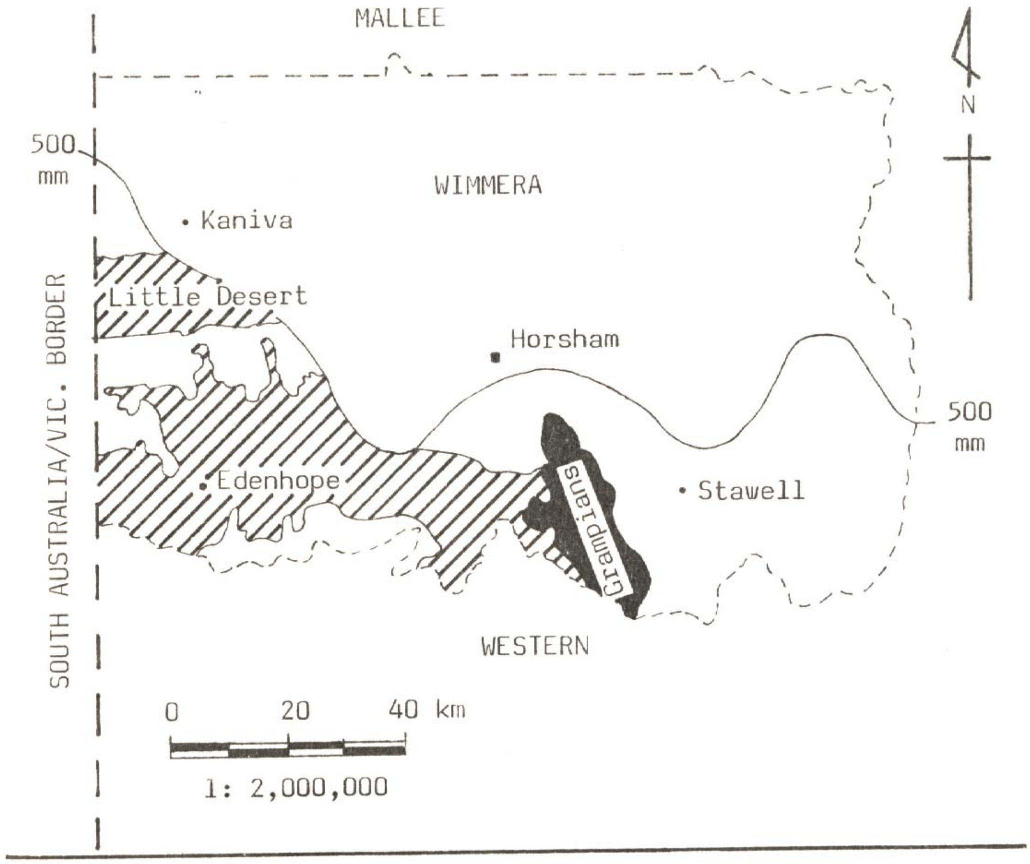


Figure 3 Distribution of the Common Occurrence of Soil 2 (Uc 2) Within the Study Area

SOIL 3 - SANDY PEDAL MOTTLED – YELLOW DEUPLEX SOILS (DY 5.4)

3.1 Soil Morphology

3.1.1 Distinguishing Features

- Duplex texture profile (i.e. distinct texture contrast between the surface and subsoil.
- Condition of the surface soil is soft (non-hard setting).
- The A1 horizon (surface soil) is brownish grey to grey brown sand to sandy loam.
- A2 horizon (subsurface soil) is present and strongly bleached.
- The depth to the clayey subsoil is usually greater than 30 cm.
- The upper most segment of the clayey B horizon (subsoil), that is at least 15 cm thick, is mottled and the dominant colours are yellow, yellow-brown, yellow-grey and grey. Mottling may increase with depth.
- The subsoils are moderately to strongly pedal. Their structural type is commonly prismatic or columnar.
- The subsoils are sodic and often contain high accumulations of total soluble salts.
- Soils reactions are weakly acid to neutral in the surface soils; alkalinity may gradually increase with depth to moderately alkaline in the deep subsoils.

3.1.2 Soil Description

These soils have distinct texture contrast between the surface horizons and the clayey subsoils. Conditions of the surface soil is soft (non-hard setting).

Surface Soils (A horizons)

A1 horizon:
This horizon is frequently darkened by some organic matter accumulations, particularly in the higher rainfall areas. Soil colour ranges from light brownish grey to dark grey brown and gradually becomes paler with depth. Soil texture ranges from sand to sandy loam and the soil material is structureless loose (single grains) to weakly coherent; gradual change to:

A2 horizon:
Comparatively thick (up to 50 cm) strongly bleached very pale brown to white sand to loamy sand; clear to abrupt boundary to:

Subsoil (B horizon)
The upper part of the B horizon is usually strongly mottled light brownish grey to yellow-brown with some red, yellow or brown, sandy clay. Subsoil texture gradually changes to heavy clay and the degree of mottling may increase with depth. Degree of pedality is either moderate or strong and the structural units vary from blocky peds<5cm in size to large prisms and columns. The deep subsoils, however, are almost structureless massive and have diffuse boundary to weathered sandy parent material (C horizon) at depths of 1-2 m.

Soil pH
Soil reaction is slightly acid to neutral at the surface and may gradually increase to moderately alkaline with depth.

Soil inclusions
Accumulations of black ferro-manganiferous (soft and hard)inclusions often occur, in varied amounts, in the A2 and B horizons.

Soft and hard nodules of carbonates (lime) may be found in the deep subsoils of some profile forms (Dy 5.43).

Ironstone gravels occur in varied amounts in some soil profiles, particularly at the A/B interface, and in large amounts in soils associated with lateritic residuals.

3.2 Agricultural significance

(a) Waterlogging
The water infiltration rate for the sandy surface soils is far greater than for the clayey subsoils. Consequently, short term saturation and perched water tables in the A2 horizons are commonly found following heavy rains.

(b) Root Development
The tight clay subsoils offer high resistance to root penetration, reducing a plant's ability to use subsoil moisture and nutrients.

(c) Inherent Fertility
The inherent fertility of these soils is low.

i) The surface soils have low contents of organic matter and phosphorus and are often deficient in t race elements, eg. Zinc, copper, and molybdenum. Clay contents are also low, and markedly so in the subsurface horizons.
ii) The dense clayey subsoils are commonly sodic and contain high amounts of total soluble salts.

(d) Erosion
On ridges and lunettes, these loose sandy soils are susceptible to wind and water erosion, particularly where adequate vegetative cover is lacking. The structural instability of the sodic clay subsoil aggregates often results in gully erosion.

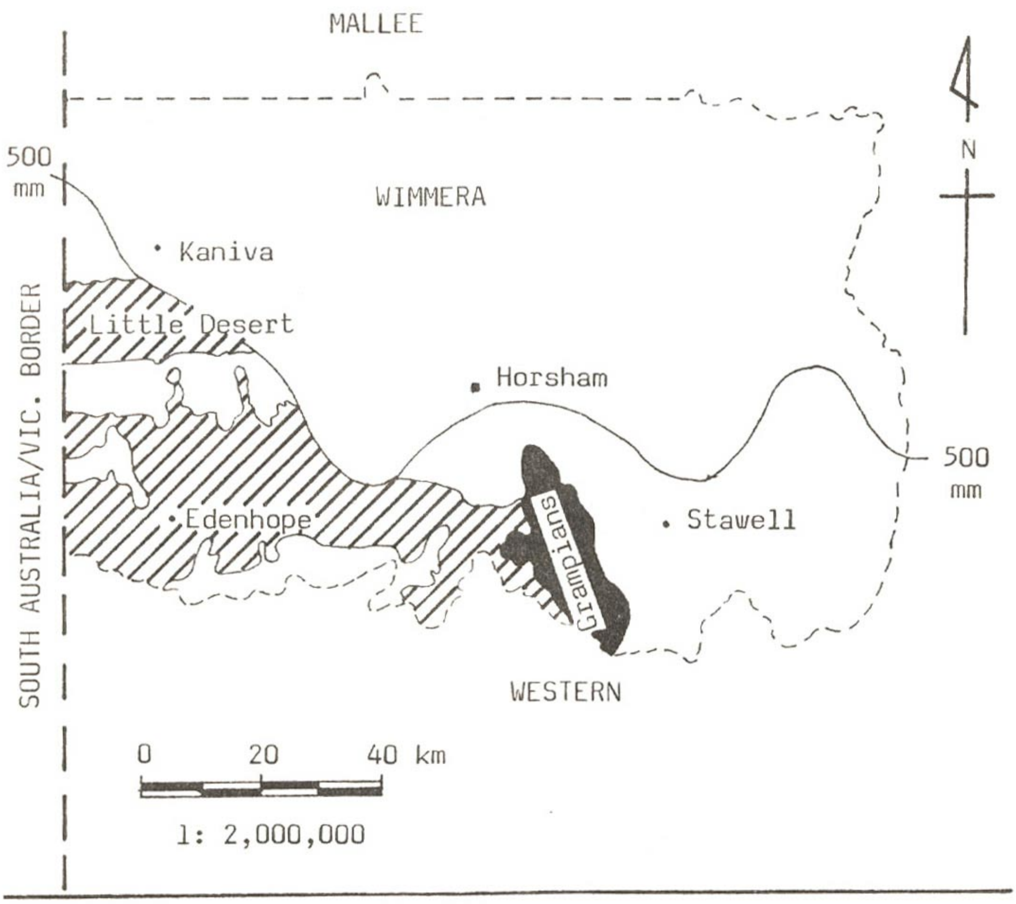
3.3 Occurrence

The sandy mottled yellow duplex soils are commonly found on the undulating sand plains of the Little Desert and in other locations scattered between the Grampians and the Victoria/South Australia border (Figure 4). These soils are usually associated with the sand sheets, dunes and hills which are common in the Southern Wimmera

3.4 Land Use

These soils are commonly used for cattle and sheep-grazing on native and improved pastures. In some areas these soils are also used for cereal and forage cropping with various degrees of success.

Figure 4 Distribution of the common Occurrence of soil 3 (Dy 5.4) within the Study Area



SOIL 4 - HARD PEDAL MOTTLED-YELLOW DUPLEX SOILS (DY 3.4)

4.2 Soil Morphology

4.1.1 Distinguishing Features

- Duplex texture profile (i.e. distinct texture contrast between the surface and subsoil).
- After wetting and drying, condition of the surface soil is hard setting.
- The A1 horizon (surface soil) is grey-brown to light brownish grey loamy sand to clay loam.
- A2 horizon (subsurface soil) is present and strongly bleached. It is massive and usually very hard when dry
- The upper most segment of the clayey B horizon (subsoil), that is at least 15 cm thick, is mottled and the dominant colours are grey brown, yellow brown and brownish grey. With depth, mottling may decrease and the main colours tend to become yellower and paler

- The subsoils are moderately to strongly pedal. Their structural type is commonly prismatic or columnar, breaking to smaller blocky peds.
- The subsoils are sodic and often contain high accumulations of total soluble salts.
- Soil reactions are mildly acid to neutral in the surface horizons; alkalinity may gradually increase with depth to moderately alkaline in the deep subsoils.

4.1.2 Soil Description

In these soils, the surface horizons have a distinct texture contrast to the clayey subsoils. Upon wetting and drying the surface soil material is characterised by the hard setting condition.

Surface soils (A horizons)

A1 horizon:
Grey-brown to light brownish grey loamy sand to clay loam, structureless massive; gradual to clear boundary to:

A2 horizon
Conspicuously bleached near white subsurface soil of similar, or slightly coarser, texture than the A1 horizon. The soil material is massive and hard to very hard when dry; clear to abrupt change to:

Subsoil (B horizon)
The upper part of the B horizon is usually distinctly mottled brownish grey to yellow-brown with some red, yellow or light grey sandy clay to heavy clay. The degree of pedality in the subsoil is moderate to strong and the structural units are prismatic or columnar which often break to smaller blocky peds. Soil consistency is very hard t o extremely hard (dry), non-friable (moist) and very sticky (wet).

In the deep subsoils, texture gradually changes to heavy clay, the degree of mottling decreases and the main colours become more yellow and paler. Soil structure changes into moderate, fine to medium angular blocky.

Soil pH
Soil reaction is mildly acid to neutral at the surface and alkalinity may increase with depth. In the study area, neutral and alkaline soil reaction trends (Dy 3.42 and Dy 3.43, respectively) are common.

Soil inclusions
Some soft and hard carbonate (lime) aggregations may occur in the deep subsoils of some profile forms (Dy 3.43).

Ironstone gravels and rock fragments are often present, in various amounts, in the soil profile and are usually concentrated in the lower A2 horizon.

Accumulations of black ferro-manganiferous (soft and hard) inclusions are also commonly present, in varied amounts, in the lower A2 horizon and often extend into the upper segment of t he clayey subsoil.

4.2 Agricultural Significance

4.3

a) Condition of the surface soils
In general, these soils are considered to be difficult to manage due to their narrow range of moisture contents at which optimum workability can be achieved. When wet, the surface soils become water logged and their aggregates readily disperse resulting in a compacted hard setting cultivation layer upon drying.

b) Crop establishment
The hard setting condition of the surface horizons of these soils makes crop establishment difficult.

c) Soil permeability
Water infiltration rate is commonly moderate to low in the surface soils (depending on soil texture and degree of compaction) and is essentially low in the subsoils.

Permeability problems often result in:

- waterlogging, intermittent perched water tables in the subsurface horizons (a2) and partial saturation of the upper B horizons.
- loss in surface moisture through run off and/or evaporation.

d) Aeration

Aeration is usually deficient in these soils due to surface soil compaction and the high density of t he subsoils.

e) Root penetration

In addition to the cemented bleached subsurface horizons, the tight clay subsoils offer high resistance to root penetration. It is common therefore in these soils to find t hat root development is confined to the surface horizons and that the majority of roots extend along the tops of subsoil columns rather than penetrating into deep subsoils.

f) Inherent fertility

The inherent fertility of these soils is low to very low. They are usually deficient in phosphorus, nitrogen and various trace elements.

The subsoils are sodic to strongly sodic and have moderate to high concentrations of soluble salts.

g) Soil erosion

On sloping sites erosion is a hazard becoming more sever where the soils are disturbed or have lost their vegetative cover. Deep eroded gullies are also commonly caused by the structural instability of the sodic subsoils.

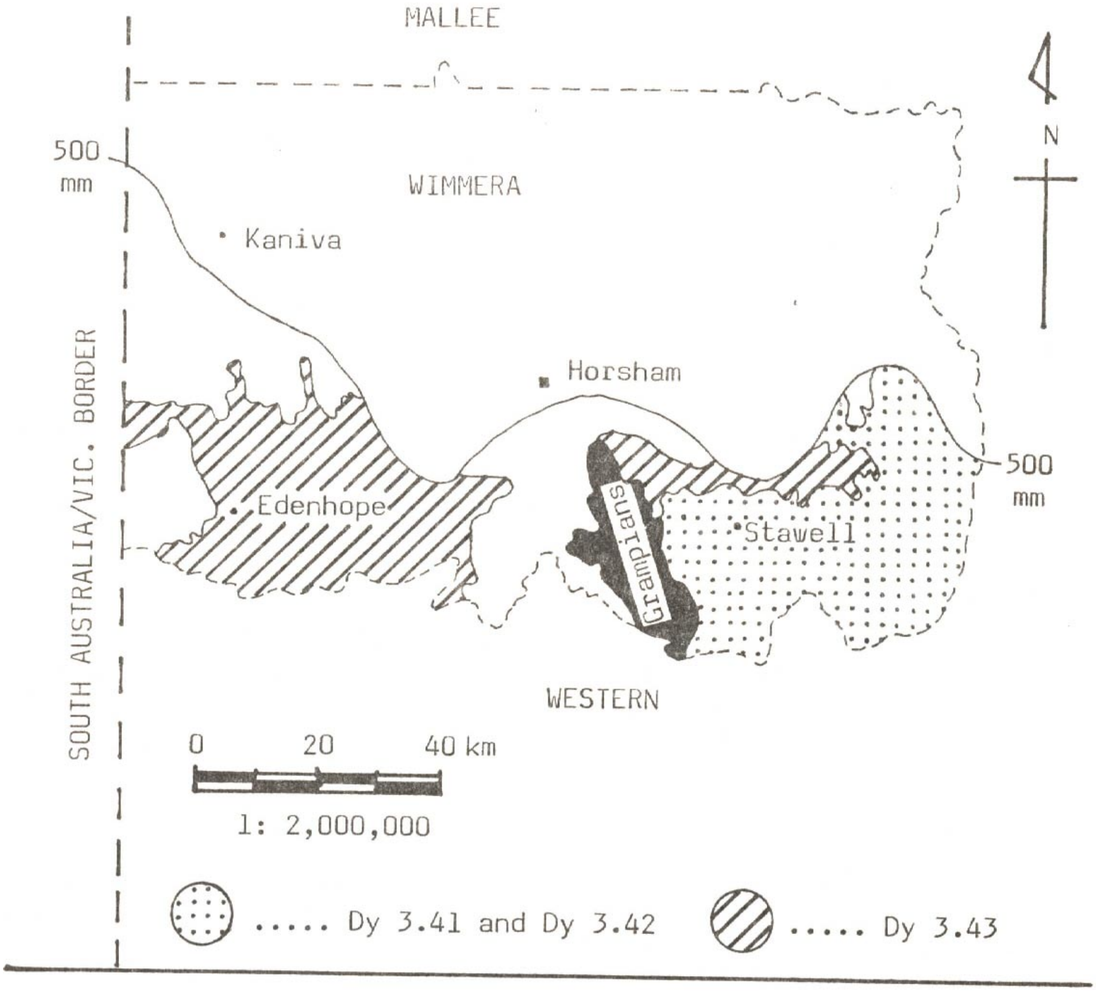
4.3 Occurrence

These soils occur on undulating valley plains and hilly areas. The soil profile forms with the acid and neutral reaction trends (Dy 3.4 and Dy 3.42, respectively) are commonly found I most of the eastern section of the study area. The soil profile form with the alkaline reaction trend (Dy 3.43) is dominant in a narrow strip extending from the northern out wash slopes of the Grampians to some 25 km north east of Stawell. In the western section of the study area, however, the Dy 3.42 soils are co-dominant with soils 2 and 3 (Uc 2 and Dy 5.4, respectively) occupying flat areas and lower to mid slopes (figure 5).

4.4 Land use

These soils are mainly used for sheep grazing on native, volunteer or sown, pastures. In some drier areas, however, the soils are utilised for cereal cropping and for limited horticulture.

Figure 5 Distribution of the common occurrence of soil 4 (Dy3.4) within the study area



REFERENCES

1. Northcote, K.H. (1960a) “Atlas Of Australian Soils.” Map And Legend No 1 – Dominant Soils For Sheet 1, Port Augusta – Adelaide – Hamilton Area (C.S.R. I. R. O. Aust.) And Melb. Univ. Press (Melbourne).

2. Northcote, K.H. (1960b). “Atlas Of Australian Soils.” Explanatory Data For Sheet 1, Port Augusta – Adelaide – Hamilton Area (C.S.I.R.O. Aust And Melb Univ Press, (Melbourne).

3. Northcote, K.H., Hubble, G.D. Isbell, R,F., Thompson, C.H. And Bettenay, E.(1975). “A Description Of Australian Soils.” (C.S.I.R.O. Aust.).

4. Northcote, K.H. (1979) “A Factual Key For The Recognition Of Australian Soils.” 4th Edition (Rellim Technical Publications: Glenside, S.A.).

5. Stace, H.C.T., Hubble, G.D., Brewer, R., Northcote, K.H., Sleeman, J.R., Mulcahy, M.J. And Hallswroth, E.G. (1968). “A Handbook Of Australian Soils.” (Rellim Technical Publications: Glenside, S.A.).

Appendix - Definition of Soil Terms

AGGREGATE STABILITY
The stability of the soil aggregate to water falling as rain or applied as irrigation.

BLEACHED
Describes a soil horizon which has become pale in colour owing to leaching.

CALCAREOUS THROUGHOUT
Means that calcium and/or magnesium carbonates occur throughout the soil profile. Carbonates may be visible or detectable by the application of 2 or 3 drops of N HCL to a representative sample of the soil.

CONDITION OF SURFACE SOIL
Refers to the natural condition of the surface soil and its reaction to the usual wetting and drying cycle. Cultivation will often alter the condition of surface soil, but most conditions will reform when the soil is left undisturbed.

CONSISTENCE
Comprises the attributes of soil material that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation or rupture. It is markedly affected by the moisture state of the soil. Terms used for consistency include: soft, hard, friable non-friable, plastic and sticky.

DUPLEX SOIL PROFILE
Refers to a soil profile showing a marked difference in texture between the surface and subsoil horizons. Texture contrast must be at least one and a half texture groups between A and B horizons (Northcote, 1979).

FIELD CAPACITY
The percentage of water remaining in a soil two or three days after having been saturated and after free drainage has practically ceased.

GILGAI
An uneven surface manifestation of puffs and depressions often referred to as crabholes or melonholes.

GYPSUM
Hydrated calcium sulphate.

HARDPAN
A hardened and/or cemented horizon in or below the soil profile.

HARDSETTING
A surface soil is considered to be hard-setting when it becomes hard and apparently a pedal on periodic drying out.

LIME
Calcium carbonate either finely divided or in concretions (hard nodules).

MORPHOLOGY
The physical constitution of the various horizons and their arrangement in the soil profile.

MASSIVE
Structureless, i.e., “apedal”.

PED
An individual natural soil aggregate.

PEDALITY
Refers to the relative proportion of peds in the soil, a follows:

> **<u>Highly pedal (= pedal)</u>**: in the moderately moist to the moist state, one third or more of the soil material consists
>
> **<u>Weakly pedal:</u>** in the moderately moist to the moist state, less than one third of the soil material consists of peds
>
> **<u>Non-pedal:</u>** essentially no recognisable peds.

SELF MULCHING
Self-mulching is that condition of the surface soil, notably of clays, in which a high degree of pedality is exhibited with the peds falling apart, naturally, as the soil dries to form a loose surface mulch. In cultivated soils, ploughing when wet may appear to destroy the surface mulch which, however, will reform upon drying.

SMOOTH FAVIC (=SMOOTH-PED FABRIC)
Peds are evident, and characteristically more than 50 per cent of them are smooth-faced, that is, have a general Iac condition on their surfaces.

SODIC
The term refers to those soils which have an exchangeable sodium percentage value of 6 or more and which as a consequence may exhibit physical properties to plant growth.

SOIL BOUNDARIES
The boundary between soil horizons defines the nature of the change from one horizon to that below. In this report it is specified by the measure of the thickness (or width) of the transition zone between horizons thus:

-Sharp (or Abrupt)	= boundary< 2 cm wide.
-Clear	= boundary is 2-5 cm wide.
-Gradual	= boundary is 5-10 cm wide
-Diffuse	= boundary> 10 cm wide.

SOIL HORIZON
A layer of soil, more or less parallel to the land surface, similar throughout and recognisably different from the material above and below. The horizon may be distinguished by differences in one or more of the following characteristics: colour, texture, structure, consistence, mottling, organic matter content and the presence of visible products of weathering and leaching such as calcium carbonate, gypsum, iron oxide and ferruginous concretions. The following horizons in the soil profile may be recognised:

> ***Surface or A horizon:*** The surface layer of the soil in which organic matter has accumulated and which may be partly leached of clay and soluble material. It may be divided into two or more sub-horizons as follows:
>
> ***A1 Horizon***: The surface soil more or less darkened by organic matter – a zone of maximum biological activity.
>
> ***A2 Horizon*:** A sub-surface layer lower in organic matter than the A1 and in consequence, usually lighter in colour. It is the zone of maximum leaching.
>
> ***Subsoil or B Horizon*:** Situated below the surface or A horizon and is usually heavier in texture than that horizon The B horizon represents the zone of accumulation of clay and other materials, including calcium carbonate and iron oxides.

SOIL PROFILE
Indicates the general direction of pH changes down the profile, e.g.

> ***Acid Trend***: The pH values are, for the surface soil, lower than 7.0,

And for the deep subsoil less than 6.5.

Neutral trend: The pH values are, for the surface soil, between 5.0 and 8.0, and for the deep subsoil, between 6.5 and 8.0.

Alkaline trend: The pH values are, for the surface soil, higher than 5.0, and for the deep subsoil, higher than 8.0.

STRUCTURE
Describes the way in which the primary soil particles are arranged into soil aggregates (peds).

TEXTURE
Soil texture is a measure of the behaviour of a small handful of soil when moistened to sticky point (approximately to field moisture capacity), kneaded into a ball and then pressed out between thumb and forefinger. It is strongly influenced by clay content and is affected by other properties, including clay mineral type, organic matter, oxides, carbonates and exchangeable cations.

Texture is described in terms of texture grades, examples of which are:

Sand, sandy loam, sandy clay loam, clay loam, light clay, medium clay and heavy clay.

UNIFORM TEXTURE PROFILE
Refers to the soil profile dominated by the mineral fraction with small, if any, texture differences throughout.

WILTING POINT (PERMANENT WILTING PERCENTAGE)
The water content of a soil when indicated plants growing in that soil wilt and fail to recover when placed in a humid chamber