NATIONAL SOILS CONFERENCE
Canberra 18-23 November 2018

Conference Tour, Wednesday 21 November, 2018

Young Region Horticultural Soils

SOIL SCIENCE AUSTRALIA

Young Region Horticultural Soils

Compiled for Soil Science Australia by Roy Lawrie, NSW Soil Knowledge Network

Red earthy soils, like this profile exposed in a cutting on Boundary Road, are typical of the district around Young, about 150 km northwest of Canberra.

Contents

Acknowledgements

The invaluable assistance of Brian and Sue Mullany of Grove Estate Winery, Geoff Cartwright of Young and Peter Mullany of Ballinaclash is greatly appreciated. Thanks are also due to Ian Packer, Brian Jenkins and Peter Fogarty of SKN, Susan Orgill, NSW DPI, Richard Greene, ANU and Lisa Lawrie, Soil and Landscape Studies.

http://www.nswskn.comhttps://www.facebook.com/NSWSKN/

The NSW Soil Knowledge Network Inc. is a group of retired and semi-retired soil specialists who are passionate about soil and the land. They are an independent, not-for-profit group, which captures critical soil knowledge and experience.

The NSW Soil Knowledge Network is a highly valuable resource. The group is available as mentors and trainers to support natural resource managers and land users in NSW.

SKN wants to share knowledge and help others understand the importance of soil, the value of quality soil information, and help people make evidence based decisions.

Soil Legacy Information

Preserving valuable soil information and making it available to the next generation of land managers is a key priority for SKN.

They are currently collecting and assessing many documents, with the aim of preserving historical soil information. Simply because data is old does not mean that is isn't valuable. Indeed, legacy information may be the best that is available.

SKN has uploaded around 1400 legacy documents to the OEH soil publications page. Topics include alpine management, in particular the Summit Area Works Program, rangeland management, erosion, land use planning, soil surveys and much more.

Visit http://www.environment.nsw.gov.au/topics/land-and-soil/land-and-soil-publications

Itinerary - Wednesday 21 November 2018

8 am	Depart Canberra
10 am	Morning Tea, Boorowa; CSIRO research facility under construction
11 am	Inspect soil pits in Young vineyard, off Spring Creek Road, 300 m south of Tumbleton Lane corner
1 pm	Lunch, Grove Estate Winery, 4100 Murringo Road, Young,
	Soils and Horticulture Q & A session
2:30 pm	"Ballinaclash" orchard, 4321-4335 Olympic Highway Young, soil pits, cherry picking/tasting
4:30 pm	Lookout over Murrumbidgee River, Jugiong
6: 30 pm	Arrive Canberra

Introduction

Young is known for its deep red soils that support a wide range of agricultural activities. The field trip aims to provide an overview of the main soil types, together with some aspects of their origin and management, particularly for horticulture.

Agricultural settlement of the district began in 1826 with sheep grazing on "Burrangong" station. Land use has since diversified and now also includes beef cattle, fat lamb raising, cereal and oilseed cropping as well as stone fruit and wine grape production. Cherries have been grown at Young since 1847, with the first commercial orchard planted in 1879 (Dirou, 1977).

Detailed soil studies began in the 1960's and some of this legacy data is reproduced in this field guide. The NSW Soil Knowledge Network is working to increase awareness of this older, largely non-digitised, soils information so that important findings are used effectively by both researchers and landholders interested in better soil management.

Landscape, climate and parent material

Young is 440m above sea level located in a weakly dissected upland with gently rolling to undulating terrain. Fruit growing areas are 350-550m in elevation. Average rainfall in Young is 660mm annually. Reliable rain generally falls in winter and spring (see Figure 1). Late summer and autumn is a time for occasional heavy storm rainfall. The district in summer is very warm to hot, with frosty winters especially on the valley floors.

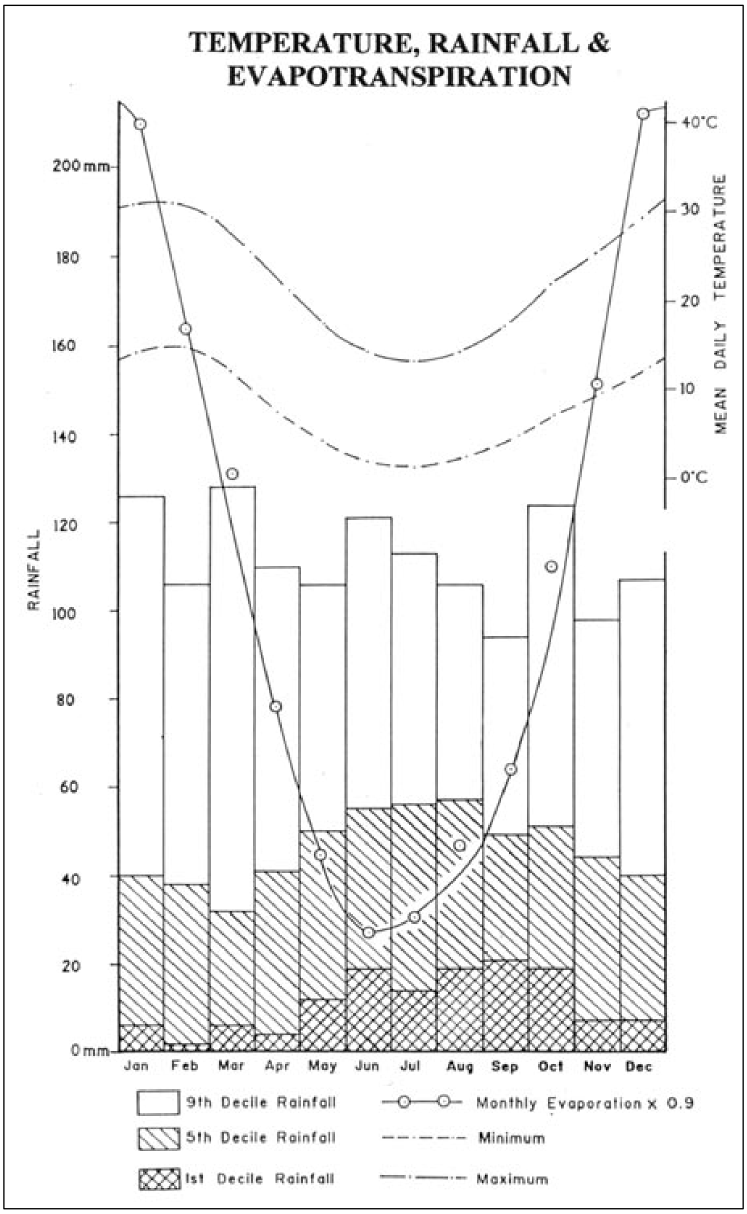

Figure 1. In Young between May and August median rainfall (5th decile) is above estimated monthly evapotranspiration (0.9E). In September there is usually a small moisture deficit which rises quickly as spring progresses; this is when trees and vines start to draw on reserves of stored soil moisture. The mean daily maximum temperature is 30 degrees or more for the 3 months of summer.

The underlying rock is granite or granodiorite (see geological map, Figure 2), which is often riddled with white quartz veins that are more resistant to weathering. Colluvial action and erosion of the surrounding softer and often deeply weathered bedrock has left some of this quartz gravel in surface soils or buried deeper in the subsoil (see Figure 3, Figure 4, Figure 5). Other profiles have mixed gravelly A_2 horizons (Figure 6), or contain ironstone gravel layers buried under a gravel-free red-brown clayey B horizon (Figure 7).

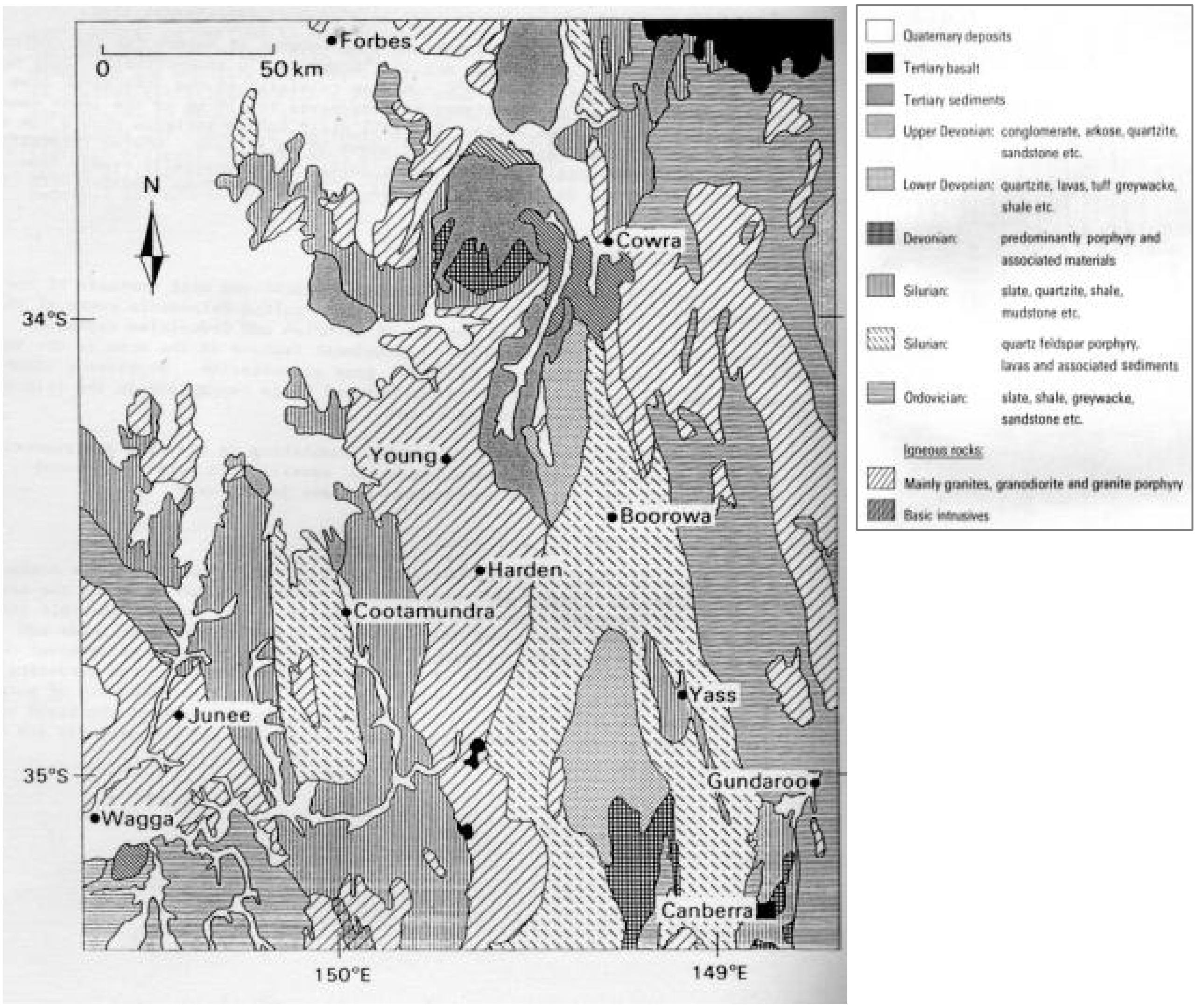

Figure 2. Geological map from post-conference tour booklet, May 1988, Aust. Soc. Soil Science Inc.

Figure 3. Colluvial action in the past has spread gravel remnants of this quartz vein on top of the saprolitic pallid clay (note metre rule on right)

Figure 4. A largely intact quartz vein, extending up to the A horizon

Figure 5. White gravel from a colluvially disturbed quartz vein, now buried in the lower B horizon

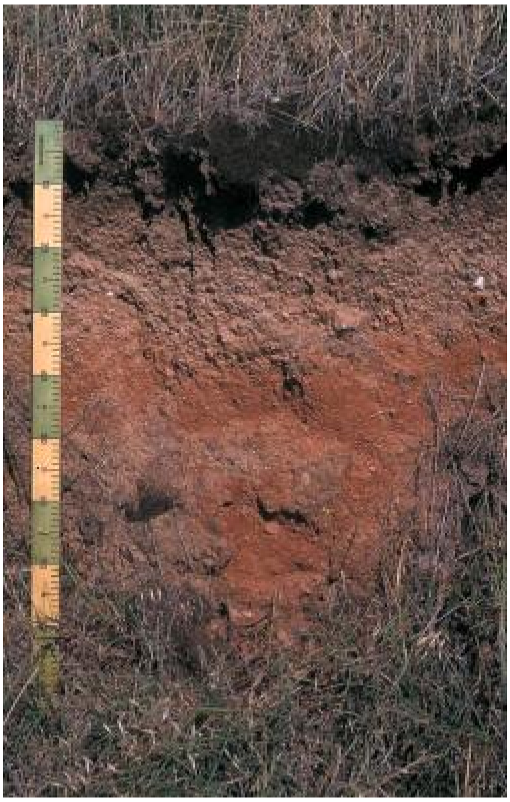

Figure 6. A gravel-rich A2 horizon above a less gravelly but more clayey and (typically) weakly structured B horizon on an upper slope 6km north east of Young

Figure 7. A band of ironstone gravel 30-50cm thick resting on pallid clay; the gravel is below the weakly structured red lower B horizon in this road cutting 4km north of Young

In the 1960s micromorphologic evidence of multiple soil-forming processes or periods of deposition was found in the subsoil of a red earth near Harden south of Young, resting on the same granitic batholith (see Figure 8 from p.268, Stace et al, 1968).

REMARKS: (1) The dominant processes have been weathering of a granitic parent material, clay illuviation and segregation of sesquioxides and manganese oxides as nodules and colour mottling in the lower horizons.

(2) There are three maxima of illuviated clay (at 10 in. (25 cm.), 18 in. (45 cm.) and 61 in. (154 cm.)). These suggest three successively younger profiles overlying each other. However, the boundaries between these three profiles are not clear-cut, possibly due to truncation of the older profiles. The material between 12 in. (30 cm.) and 16 in. (40 cm.) contains nodules of the underlying material suggesting that 16 in. (40 cm.) is the base of the youngest profile, the soil nodules being due to mixing of material at a sedimentary boundary. If this is so the underlying profile was truncated since the 16 in.-32 in. (40 cm.-80 cm.) zone has the characteristics of B horizon material including frequent void argillans. The upper boundary of the oldest profile may be between 48 in. (122 cm.) and 54 in. (138 cm.), where there is a marked change in plasmic fabric, or at 35 in. (90 cm.) where there is a sudden large decrease in proportion of void argillans and manganiferous concentrations compared with the material above; it is not clear whether the 35 in.-51 in. (90 cm.-130 cm.) zone belongs to the intermediate profile or the oldest profile.

(3) The material below 51 in. (130 cm.) contains increasing proportions of weathered biotite and is relatively weakly weathered, while all the material above 51 in (130 cm.) contains very low proportions, or no biotite, and is relatively strongly weathered. In addition the oldest profile has the least amount of illuviated clay.

Laboratory Data – Profile 25A

CHEMICAL AND PHYSICAL ANALYSIS
< 2 mm FRACTION

No.	pH H_2O 1:1	pH H_2O 1:5	pH 0.1M $CaCl_2$ 1:2.5	Air-Dry Moist %	Sol. Salt	Cl as NaCl	Ign. Loss	$CaCO_3$	Org. Mat.	N	P	K	S	Particle Size CS	FS	S	C	Ex. Cap.	Ex. Cations Ca	Mg	K	Na	Avail. P p.p.m. O.D.
					Per Cent Oven Dry Weight													m-equiv./100g O.D.					
1	5.8	6.0	5.0	1.5	0.02	0.01	5.5		2.5	0.12	0.04	-1.9	0.04	26	41	10	22	14	4.7	2.0	1.4	<	18
2	5.7	5.9	4.9	1.8	0.01	<	5.1		1.5	0.08	0.03	1.9	0.02	26	39	10	26	13	4.3	1.7	1.0	<	6
3	6.1	6.3	5.5	2.1	0.01	<	4.6		0.7	0.04	0.02	1.9	0.01	25	35	7	32	13	3.9	2.0	0.8	<	3
4a	6.2	6.4	5.7	2.4	0.01	<	5.4		0.6	0.03	0.02	1.8	0.02	28	25	5	41	14	4.2	2.8	0.9	<	3
4b	6.1	6.3	5.8	3.4	0.01	0.01	7.4		0.6	0.04	0.04	1.7	0.02	17	19	6	55	17	5.3	3.9	0.9	<	7
5a	6.2	6.4	5.8	3.5	0.01	<	7.3		0.4	0.03	0.04	1.7	0.01	18	19	7	57	16	5.1	4.2	1.0	0.1	10
5b	6.5	6.6	5.9	3.3	0.01	<	7.1		0.4	0.03	0.04	1.7	0.01	17	18	8	57	16	4.8	4.9	0.9	0.1	11
6	6.4	6.5	5.9	3.3	0.01	<	7.3		0.4	0.02	0.04	1.8	0.01	19	16	9	56	16	4.9	4.9	0.8	0.2	12
7	6.6	6.7	5.9	2.7	0.01	<	7.0		0.3	0.02	0.03	1.9	0.01	18	16	9	56	17	4.7	5.8	0.6	0.4	5
8	5.1	5.4	4.3	2.9	0.01	0.01	6.1		0.2	0.01	0.01	2.4	0.01	26	19	13	43	21	6.3	7.8	0.3	0.7	2

WHOLE SOIL

No.	Gravel %	Water Retained 0.1 bar cc/cc	Water Retained 15 bar cc/cc	Bulk Dens. g/cc
1	2	0.27	0.13	1.6
2	2			
3	3	0.29	0.20	1.4
4a	5			
4b	4	0.38	0.27	1.4
5a	3			
5b				
6	5			
7	9			
8	16			

SILICATE ANALYSIS < 2 mm FRACTION (Ignited)

No.	Fe_2O_3	MnO	TiO_2	CaO	K_2O	SO_3	P_2O_5	SiO_2	Al_2O_3	MgO	Na_2O
	Per Cent										
1	3.34	0.11	0.74	0.22	2.35		0.12	82.17	11.08	0.28	0.30
4a	5.46	0.04	0.85	0.19	2.19		0.09	72.87	15.65	0.49	0.20

MINERALOGICAL ANALYSIS CLAY FRACTION (Air-dry)

No.	K_2O %	Ex.Cap. m-e %	I	K	Q	H
			Per Cent Range			
1	2.7	20	50-65	20-30	1	5-10
4a	2.3	24	40-50	30-40	1	10-20

Figure 8. Remarks on the micromorphology of a red earth near Harden, about 30km south of Young, noting "three maxima of illuviated clay". The sampling depths (cm) in the table of analytical data from this profile are 1 (0-10), 2 (10-20), 3 (20-30), 4a (30-40), 4b (40-60), 5a (60-80), 5b (80-90), 6 (90-120), 7 (120-150), and 8 (150-180).

An additional source of soil parent material was suggested in the 1970s, when prior stream remnants were reported on the "embayed plains" west of Young (see Figure 9).

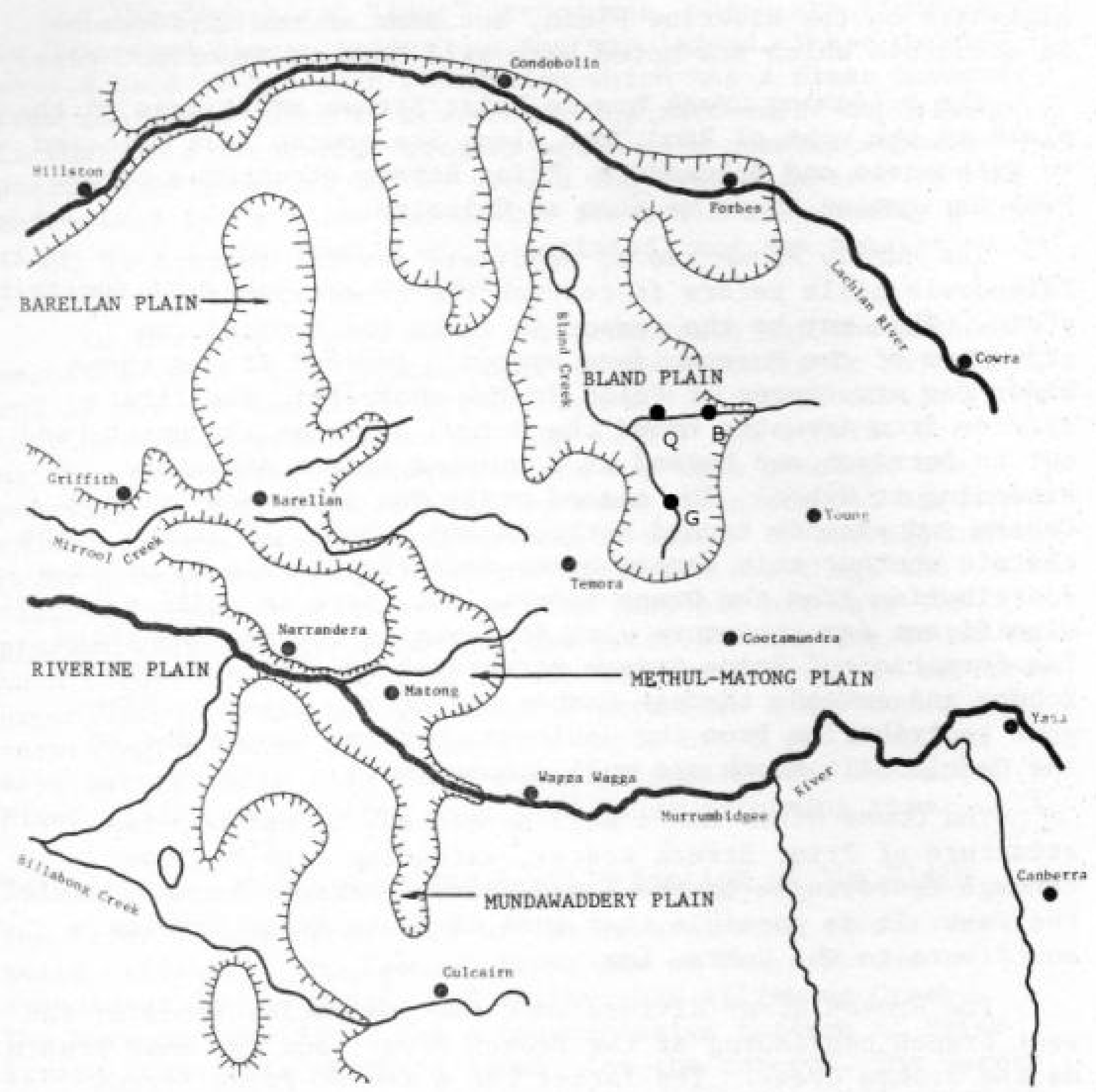

FIGURE 1.1. Sketch showing embayed plains to the east of the Riverine Plain.

The *Bland Plain* is oriented along the Bland Creek extending from north of Cootamundra to Lake Cowal. It has many of the characteristics of the main Riverine Plain including treeless plains of grey clay soils in the lower parts near the lake, and plains of red-brown earth soils in the upper parts. Prior Stream traces have been noted in the south at Grogan and further north at Bimbi and at Quandialla. These traces are associated with the local streams, not with the Lachlan River which crosses the Blain Plain further north.

Figure 9. from Butler. 1978: Prior stream traces were noted at Grogan (G), Bimbi (B) and Quandialla (Q), 40-50km west and north west of Young.

Evidence on the extent of dust accumulation in soils of the region has been gathered since the 1980s. Two profiles on granitic ridge crests between Harden and Young were examined by Walker et al, 1988. One of them (the Lynwood profile, see Figure 10) was visited in May 1988 by participants of the field trip following the

National Soils Conference held in Canberra that year. The upper profile contained very fine aeolian sand, and covered a subsoil with older dust, and also an increasing proportion of granitic grit at greater depths

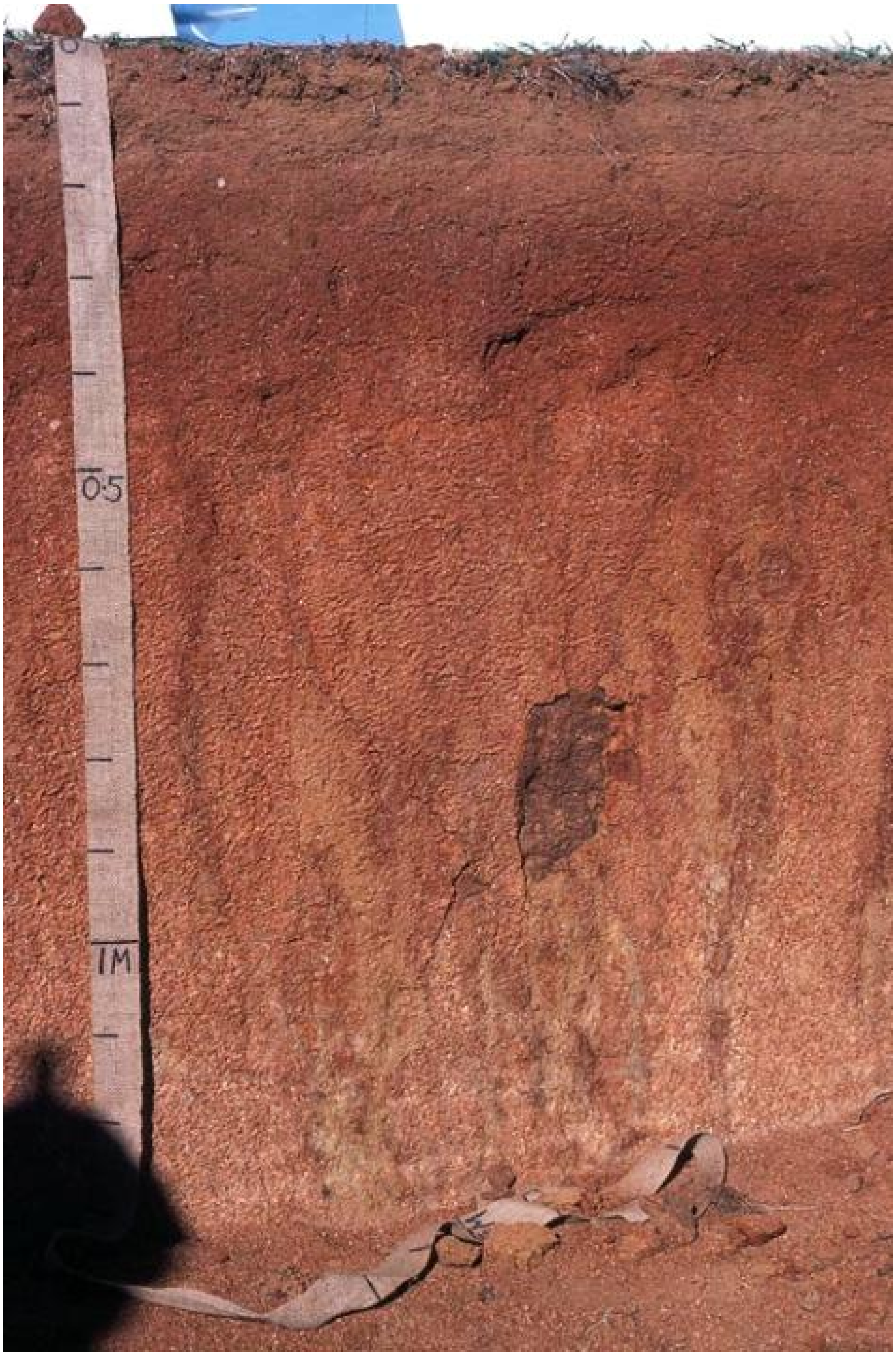

Figure 10. There is an abrupt change at a depth of 42cm in the subsoil of the Lynwood profile. Based on a detailed study of micromorphological, mineralogical and chemical properties, it was concluded that "the most recent parna accession has led to the burial of older soil materials derived from both weathered rock and earlier parnas " – Chartres and Walker, 1988.

Evidence of at least two periods of dust deposition across the region has been found in several studies. Deposition may have commenced prior to the last glacial period – a red chromosol on granodiorite near Carcoar (120km north east of Young) was found to contain dust over 50,000 years old (Hesse et al, 2003). Useful reviews of other recent work on the features and extent of these dust-derived soils may be found in Cattle et al, 2009, and Greene et al, 2009.

Soils and horticulture

In the 1980s most cherries were planted within an an 8 km radius of Young. Prompted by concern that a new town plan would allow urban expansion into this area, the soils around Young were mapped and the information used to compile a land suitability map. At this time the district was producing around 75% of the state's cherries .

The soil survey (Lawrie et al, 1993) found two contrasting groups of soils mantling the granitic hillsides (see Figure 11 and Figure 12).

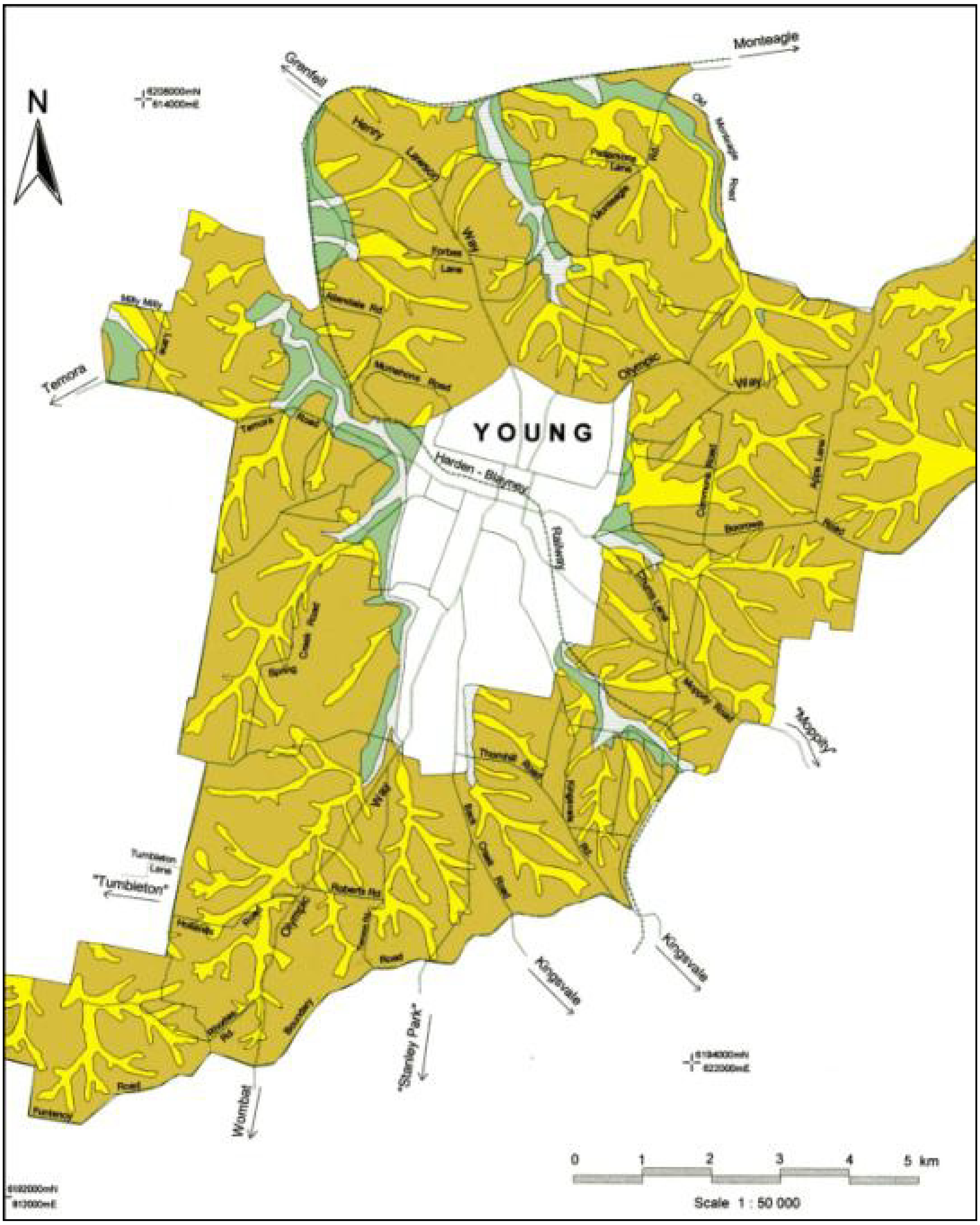

Figure 11. Soil map of the Young district (2005 digital version by Georgette Atalla).

SOIL SURVEY

YOUNG DISTRICT

NEW SOUTH WALES

To accompany Soil Survey Bulletin 10

LEGEND

Soil Association	BURRANGONG					
Landscape Position	crest , upper and middle slopes, convex part of lower slopes			concave slopes, depressions and drainage lines		
Soil Series	Burrangong			Wambanumba		
Map Unit						
Phase (in order of dominance)	deep	shallow	duplex	pallid	yellow	gradational
Great Soil Group	red earth	lithosol	red podzolic	gleyed podzolic	yellow podzolic	yellow podzolic
Common Principal Profile Form	Gn 2.11 Gn 2.12	Gn 2.11 Uc 4.11 Dr 2.81 Dr 2.51	Dr 2.81 Dy 2.81	Dy 3.81 Gn 2.91 Dy 3.62	Dy 2.81	Gn 2.21

Soil Association	LAMBING FLAT	
Landscape Position	alluvial flats, level to gently sloping	disturbed ground, dissected by stream channels, gullies and 19 th century gold mining activities
Map Unit		
Great Soil Group	layered alluvial soils red earths, yellow earths yellow podzolics and yellow solodics	(no profiles described)
Common Principal Profile Form (Limited inspections only)	Dy 3.81 Gn 2.11 Dy 2.81 Gn 2.24 Dr 2.81	

NSW Agriculture

Mapping and field work : R.Lawrie , J.Crichton , U Kan Shin , N.Haddad, 1985 - 1986

Drafting and digitising : Georgette Atalla

Richmond , November 2000

Figure 12. Soil Map legend (Lawrie et al, 1993)

Occupying the crests, upper, middle and convex lower slopes are the deep red earthy soils - red kandosols, with some red dermosols and chromosols (together termed the Burrangong series); the concave lower slopes, upland depressions and drainage lines are locations for the other group (the Wambanumba series), mainly yellow and grey chromosols (see Figure 13).

Figure 13. Typical profiles of the Young horticultural district; the transition from the well-drained red Burrangong soil (left) to the pallid and mottled Wambanumba soil (right) can occur within a few rows of trees or vines

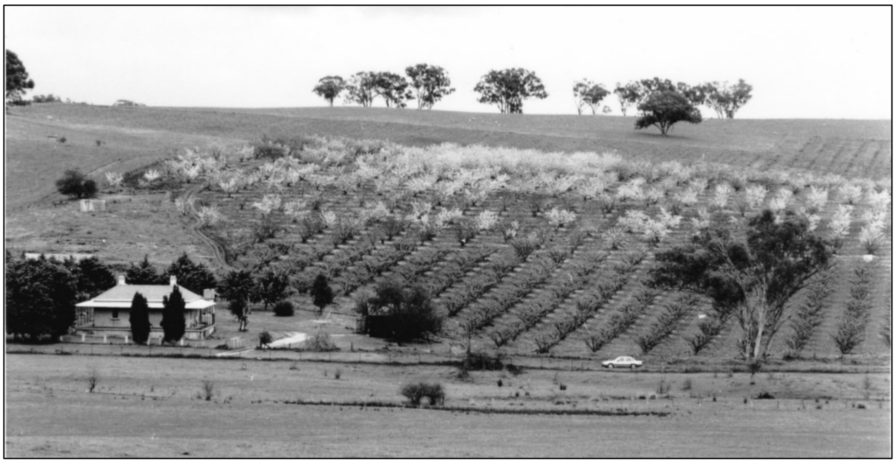

Figure 14. A typical stone fruit orchard near Young in spring 1986. Cherry trees are in blossom on the high ground, while the plum trees on the lower slope are still bare. The bottom of the slope is more frost prone and in wet years is prone to waterlogging and unsuitable for cherries

On the unpublished 1986 land suitability map (supplied to the Dept. Environment and Planning) were three map units, based on the particular combination of soil, landscape and climatic factors that affect cherry growing at Young (see Figure 14). Boundaries were delineated in the field directly onto enlarged air photos in the company of experienced local horticultural officers Geoff Cartwright and Ron Gordon.

The soil map and legend (Lawrie et al, 1993) was eventually published without an accompanying bulletin seven years later. A summary was later presented to local orchardists (see Figure 15, and to viticulturists of the Hilltops wine region.

NSW Agriculture

◆HORTNEWS◆

VOLUME 2 **JUNE 1994**

ORCHARD SOILS IN THE YOUNG DISTRICT

Roy Lawrie, Soils Chemist, BCRI Rydalmere
Peter Kennedy, District Horticulturist, Young

The aim of this information bulletin is to give orchardists some background on the nature of their soils. Most of the information is based on data collected by Mr Roy Lawrie in a soil survey completed in 1987. The original survey was prompted by a concern that a new town plan would allow urban expansion into areas suitable for cherries. Soils were examined at 83 sites along traverses 1.5 to 2 km apart, at intervals between 200-700 metres. All the sites were in uncultivated areas, most still supporting some native vegetation.

Most orchardists are aware that there are a number of distinct soils on their properties. Generally red soils exist on the ridges and tops of slopes while the colour and depth changes as we move down into the gullies.

Soil Patterns

The soils and landscapes are closely linked in the Young area. There are two distinct soil associations one mantling the granite hillsides and the other on the valley floors. On the hillsides the deep red earthy soils of the Burrangong association (Lawrie in prep.) occupy the crests, upper, middle and convex parts of the lower slopes. The concave slope areas, the depressions and drainage lines are the locations for the more variable Wambanumba series, mostly yellow or white soils.

The Lambing Flat association is developed on unconsolidated alluvial/colluvial sediments. It covers a minor proportion of the total district and consists of layered alluvial soils with some red and yellow earths.

The Burrangong series is divided into three phases - deep phase, shallow phase, duplex phase.

The most favourable is the deep phase which is a deep profile soil with dark brown fine sandy clay loam, overlying a clay loam to light clay subsoil. It is generally reddish brown in the upper part but becomes an intense red-brown at about 40 cm. The red-brown earth continues to a depth of a metre or more. Below 70 cm the texture increases to a light medium clay and iron and manganese nodules are occasionally seen. In the deep subsoil, which generally becomes earthy below a metre, are curious pockets of red brown well-aggregated clay. If bedrock is close by the clay becomes increasingly gritty with depth, otherwise a dense yellow brown clay is encountered below 1.5 m.

While much of the Burrangong series is typical of soils derived from granite there is also likely to have been accessions of wind blown material from the Riverina plain to the west. The variable depth to rock may be evidence of significant transport of material. Colluvially transported material is unlikely to have

Figure 15. Local newsletter on soils for fruit growers around Young

Figure 15 cont'd :

contributed to the extensive development of the thick soil mantles on the broad elevated ridge tops around the headwaters of the streams south of Young. It is tempting to speculate that much of the coarser sandy material in the Burrangong A horizons is derived from weathering of nearby granite outcrops with the Riverina Plain a major source of the finer fraction.

Chemical Properties

The chemical properties of the deep red earthy soils present a favourable environment for tree growth that is not readily found in many other districts. A study of 104 soil samples from the Burrangong series (from all depths) showed that salinity levels were low and general fertility indicators (e.g. Cation Exchange Capacity) were good. The soils pH ranged between 5.3 and 6.5 (in calcium chloride suspension).
By contrast the chemical properties of the lighter coloured soils are less favourable. These soils are usually used in the production of plums. In a similar group of 140 samples from the Wambanumba series nearly a third of the profiles tested have at least one sample with exchangeable sodium over 6%. Salinity levels are around double or triple the level of an equivalent Burrangong horizon. General fertility indicators of these soils show they are less fertile than the Burrangong series.

Soils Properties Important for Cherry Production

From the survey it was realised that the best cherry producing soils at Young have a number of features outlined below. The presence of these features would probably mean that any fruit tree would perform better in that particular location.

1. Surface soil is a clay loam or sandy clay loam; these medium textures provide better moisture storage than coarse textures.
2. A gradual increase in clay content with depth; the lack of a sudden increase means better drainage and aeration.
3. No pale or sandy zone below the surface; this zone is associated with low levels of major nutrients, and an underlying sudden change in clay content.
4. The subsoil is no heavier than a light medium clay; heavier textures tend to reduce moisture availability and impede drainage.
5. The subsoils are a bright red brown. The bright colour indicates good internal drainage.
6. The absence of heavy accumulations of grit or iron/manganese concretions; these reduce moisture storage and, if cemented into a continuous pan, prevent free drainage and root penetration.
7. The proportion of exchangeable sodium in the subsoil is negligible; proportions higher than 6% are associated with impermeable and waterlogged sub soils.

The high iron content of red earthy soils is probably of further benefit. This may help to counteract the release of cyanides, sulphides and other toxic substances.

SUMMARY

* The best cherry producing soils are deep, well drained, and lack an A2 horizon. This sandy low nutrient zone immediately below the surface but lying above a dense clay subsoil is an unfavourable combination of features. Tree roots become confined by the dense clay in a zone where moisture storage is limited in dry spells but quickly becomes waterlogged in wet weather. The A2 horizon is also the zone where the pH of the profile is the lowest, the incidence of aluminium toxicity the greatest and the level of exchangeable cations the least.
* Irrigation and fertiliser applications can overcome some of these limitations but poor drainage is the greatest limiting factor.
* Poor drainage has led to the death of many trees. In recent times, the wet winters of 1989 and 1990 saw many trees die the following spring and summer due to root rot in soils with perched water tables.
* Be aware of the soil types on your orchard or potential orchard and plant trees accordingly.
* Mound soils where drainage is known to be a problem and be aware of sodic soils where applications of gypsum may help.
* Plum stock and in particular, Marianna, tolerate some waterlogging, more so than cherries and peach stock.
* Wise selection and management of soils can save you money in the years ahead.

Soil chemical properties

Nearly all soils tested within the Young survey area were found to be non-saline and non-calcareous, suggesting that dust from arid desert topsoils was not a significant component of the profiles, at least in the relatively recent past. Much closer is the Bland embayed plain (Butler, 1978), a more likely source of less saline/calcareous dust. The frequently dry bed of Lake Cowal is at the northern end of the plain (see Figure 16).

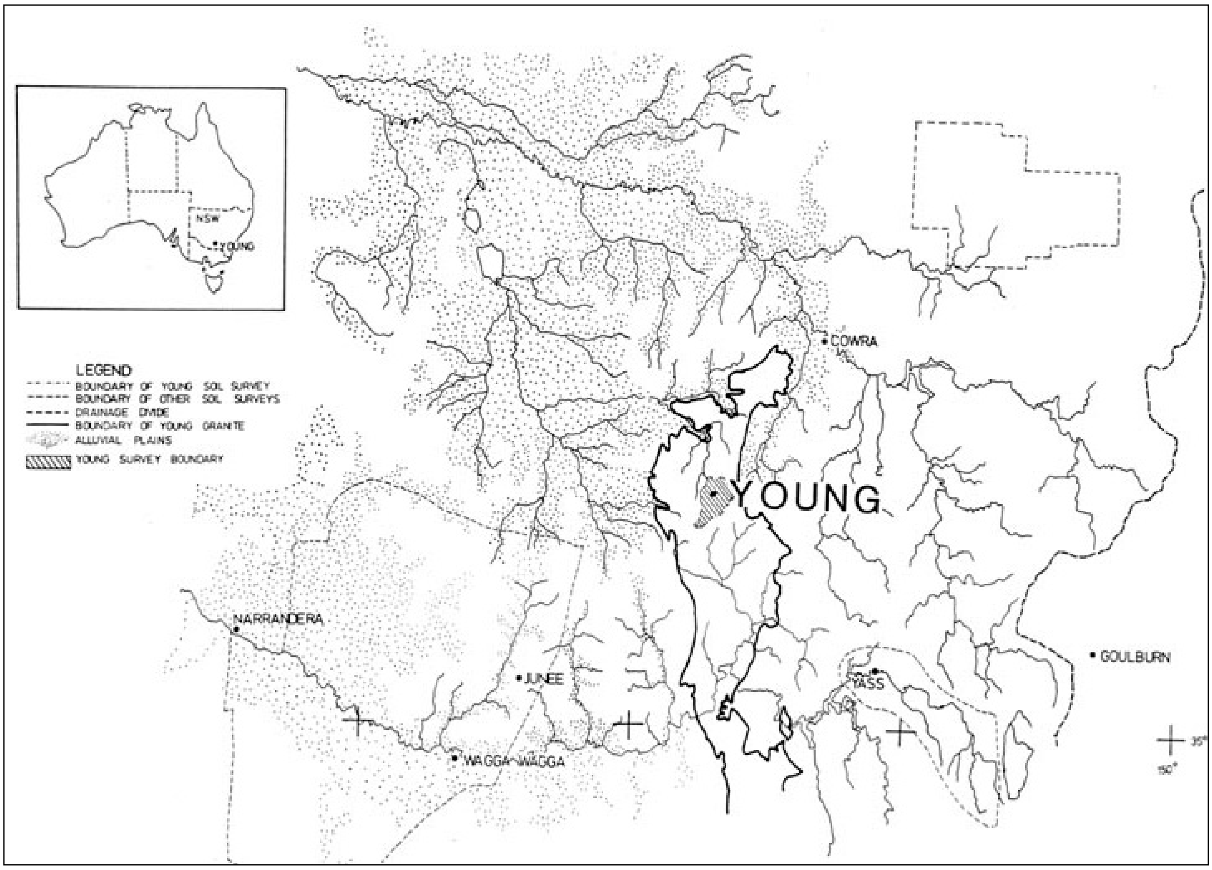

Figure 16. The town of Young is in the centre of the shaded patch that shows the area covered by the land suitability study and the associated soil survey; it is entirely underlain by the extensive granitic rock band. The figure also shows the regional drainage pattern and the alluvial plains adjoining Bland Creek. This empties into the intermittently dry Lake Cowal, 100 km north west of Young, without reaching the Lachlan River further north. Canberra is 150 km away, in the opposite direction, not far from Lake George, another ephemeral lake with no outlet.

Dryland salinity, produced by rising salty groundwater, is mostly confined to areas scattered around the base of slopes and in drainage depressions (Allworth and Gardiner, 1991). Many of these seasonally waterlogged areas around the district have been successfully rehabilitated by local Landcare groups using a range of strategies over the last 25 years. Only 9 of the 277 soil samples tested from the soil survey area around the town were saline (elec. cond. 1:5 > 0.2 dS/m). These areas were recognised as unsuitable for horticulture.

In their uncultivated state the red Burrangong soils are usually mildly acidic, as are most upper horizons in the Wambanumba soils; some of these texture-contrast profiles are more acidic in their pale sandy A_2 horizon, and more alkaline (pH >7) and sodic in their clay subsoils (see Figure 17 and Figure 18).

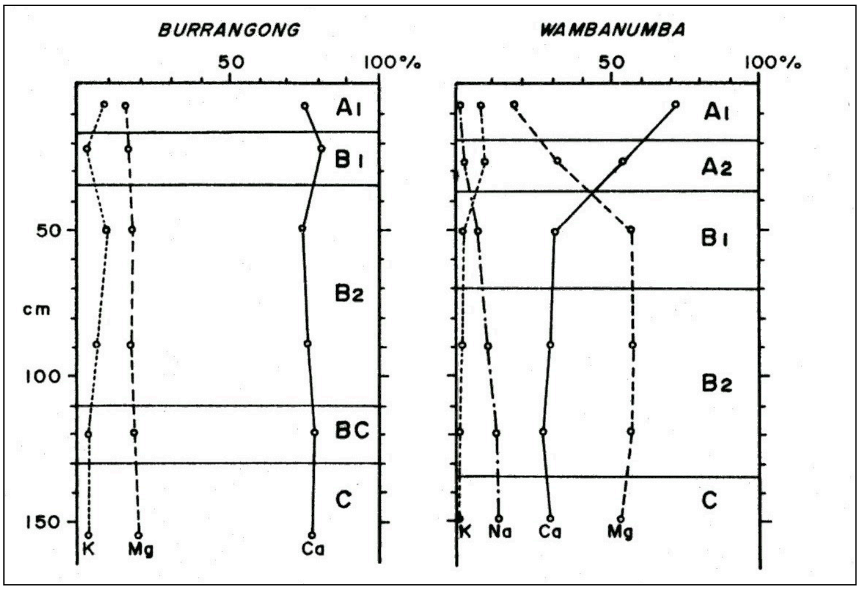

Figure 17. The proportions of exchangeable cations (expressed as a percentage of the effective cation exchange capacity) are relatively unchanged in the various horizons of this typical Burrangong soil. Note that the exchangeable sodium percentage is too low to plot in the Burrangong soil, but it increases steadily with depth in this Wambanumba soil, which also has an increasing magnesium percentage.

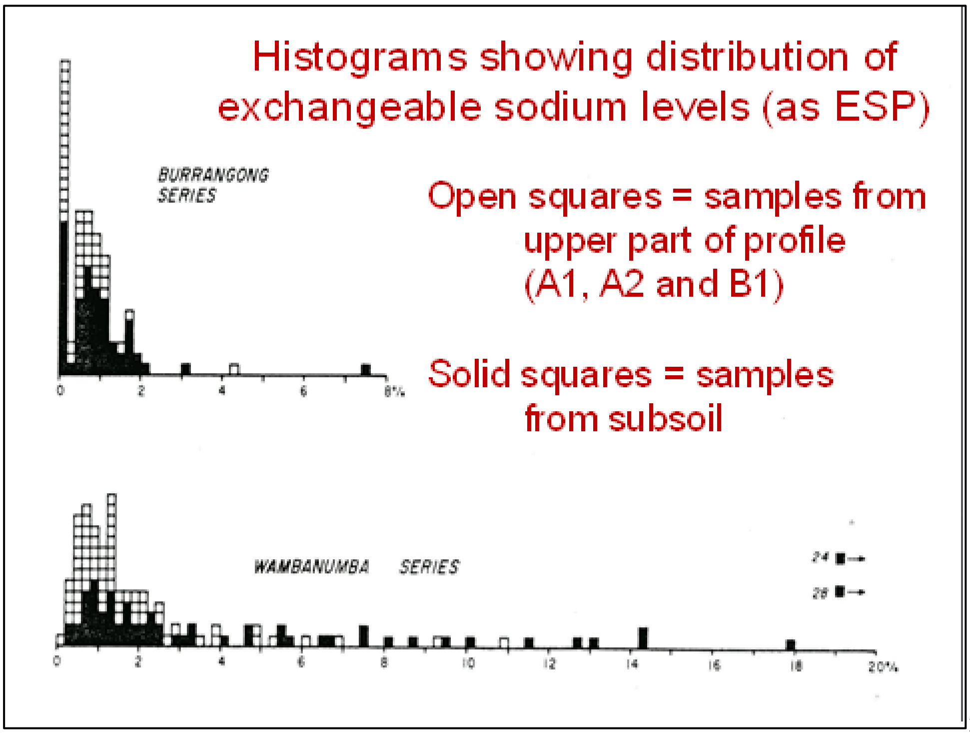

Figure 18. Many but not all Wambanumba subsoils are sodic

Although the Burrangong soils are non-sodic, their aggregates may be prone to slaking (see Figure 19). The practice of frequent cultivation in orchards, to control weeds and conserve moisture, was once widespread, particularly in prune production. This practice greatly increased the risk of erosion. In the late 1970s there were 1000 ha of prunes planted in the district. The Soil Conservation Service estimated that "over 50% of that area has lost all topsoil with most trees being left on a soil pedestal" (Hedberg, 1982). Since then, with the increasing use of supplementary irrigation, most orchards and vineyards protect the inter-row area with mown sod.

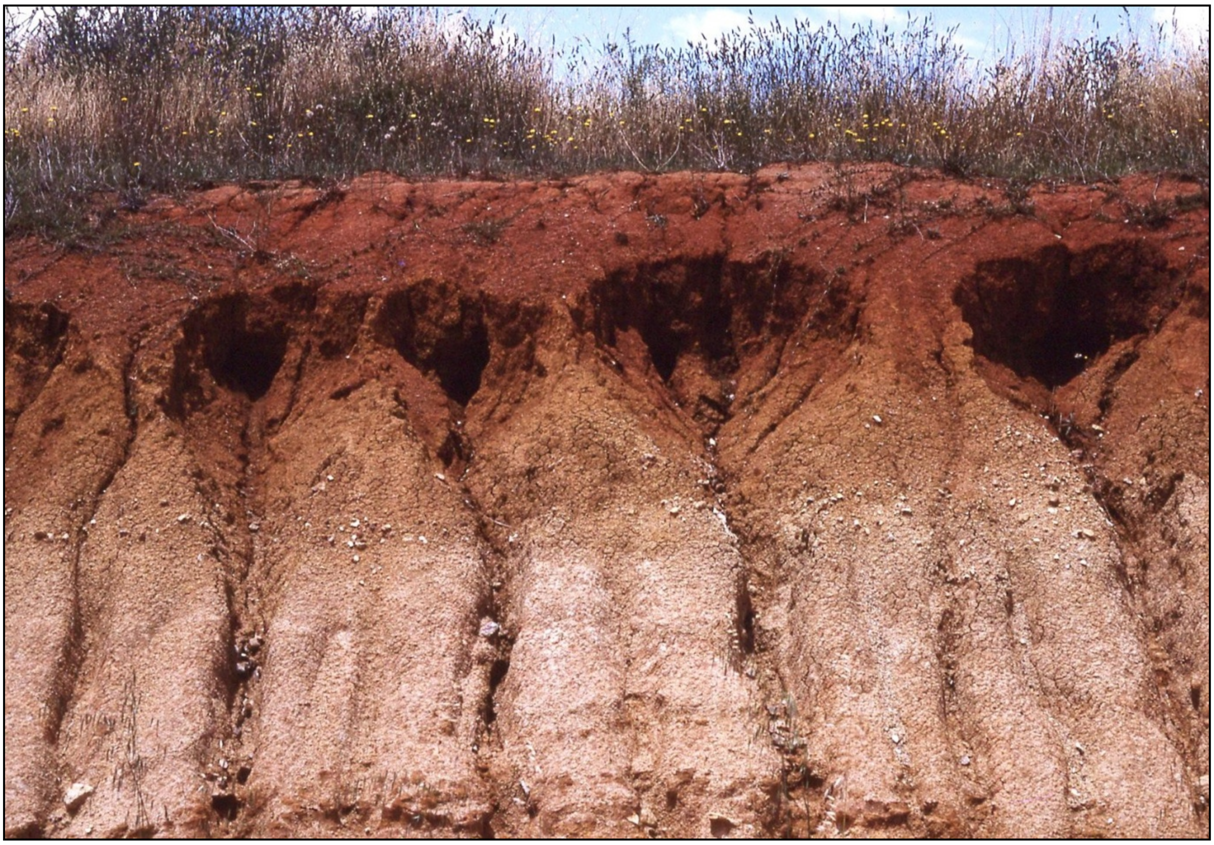

Figure 19. A red Burrangong soil in a roadside batter 2 km from Young, where the aggregates in the A and upper B horizons appear less prone to slaking than those in the lower B horizon, presumably associated with the decreasing organic matter content down the profile. The pale weathered granite in the C horizon still retains enough rock fabric to stay cohesive and resist structural breakdown.

Soil pit inspections

Two typical profiles 300 m apart were sampled for more detailed laboratory testing in 2005. The data is shown in the following section, together with a brief description. Undisturbed cores (15 cm diam.) from the same site, on an east facing slope off Spring Creek Road, 5 km south west of Young, were mounted and made into soil monoliths (photographs in following section).

Figure 20. Legacy data sources on soils of the Young area used in the compilation of this booklet. Most are listed in the References section

Burrangong clay loam - red kandosol

Depth

0 cm

brown clay loam, with fine crumb structure; many fine roots; moderate amount of organic matter non saline,non-sodic; sets hard after repeated cultivation and becomes prone to erosion

25 cm

reddish brown gritty clay; earthy and moderately well drained, with a few fine roots; low in organic matter

45 cm

red brown gritty clay; earthy and moderately well drained; crumbly when dry; good water holding capacity; non saline, non-sodic

Depth cm	EC dS/m	pH CaCl2 pH units	pH H20 pH units	Colwell Phosphorus mg/kg	PBI + Col P L/kg	Organic Carbon %	Chloride mg/kg	Total Nitrogen %	Sulfur mg/kg
	0.01	0.04	0.04	2	4	0.05	1.5	0.02	1
0-8	0.31	5.2	5.7	29	36	2.4	8.5	0.26	11
12-20	0.06	5	5.9	NT	NT	0.94	16	0.088	4
27-37	0.04	5.5	6.3	NT	NT	0.47	13	0.03	13
43-53	0.02	5.7	6.5	NT	NT	0.17	4.1	0.025	13
60-70	0.02	5.9	6.7	NT	NT	0.41	5.8	0.024	7.4
75-85	0.02	6.1	6.8	NT	NT	0.097	5.8	0.025	10

Exchangeable Cations (compulsive exchange method; CEC is sum of cations)

Depth	Al cmol(+)/kg	Ca cmol(+)/kg	K cmol(+)/kg	Mg cmol(+)/kg	Na cmol(+)/kg	CEC cmol(+)/kg
LOR	0.1	0.1	0.05	0.03	0.1	
0-8	<0.1	8.7	1.4	1.5	<0.1	12
12-20	<0.1	5.3	1.2	1.1	<0.1	7.6
27-37	<0.1	4.7	1.2	1.1	<0.1	7
43-53	<0.1	4.7	0.84	1.3	<0.1	6.8
60-70	<0.1	5.4	0.59	1.7	<0.1	7.7
75-85	<0.1	4.4	0.27	1.6	<0.1	6.3

ICP element scan – hot acid digest (USEPA 3050B)

Depth cm	Al %	As mg/kg	B mg/kg	Ca %	Cd mg/kg	Co mg/kg	Cr mg/kg	Cu mg/kg	Fe %	K %
LOR	0.0001	1	1.2	0.0001	1	1	1	1	0.0001	0.0003
0-8	1.3	2.7	2.4	0.16	<1	9.6	23	11	1.8	0.17
12-20	1.6	2.8	3.7	0.1	<1	10	26	12	2.4	0.17
27-37	2.3	3.3	3.3	0.098	<1	10	39	14	3.3	0.21
43-53	2.6	3.2	2.5	0.096	<1	11	36	14	3.6	0.21
60-70	2.8	3.5	2.1	0.11	<1	11	39	14	3.9	0.21
75-85	2.8	3.4	1.9	0.11	<1	12	41	14	4	0.2

Depth cm	Mg %	Mn mg/kg	Mo mg/kg	Na %	Ni mg/kg	P %	Pb mg/kg	S %	Se mg/kg	Zn mg/kg
LOR	0.0001	1	1	0.0001	1	0.0004	1	0.0003	1	1
0-8	0.069	1000	<1	0.0019	9.2	0.029	11	0.022	<1	20
12-20	0.063	970	<1	0.0021	11	0.017	12	0.011	<1	16
27-37	0.08	660	<1	0.0031	12	0.016	13	0.0066	1.1	18
43-53	0.088	420	<1	0.0038	12	0.015	13	0.0039	1	17
60-70	0.098	420	<1	0.0046	13	0.016	13	0.0029	1.8	18
75-85	0.1	490	<1	0.0051	14	0.017	14	0.0026	1.6	18

Wambanumba silty loam - grey chromosol

Depth

0 cm

grey brown silty loam 3 cm thick over grey structureless loam; becomes paler with depth; acidic (pH_{Ca} 4.7); moderate amount of organic matter (2% organic carbon)

25 cm

light grey structureless silty loam; gritty; prone to waterlogging; strongly leached, with very low cation exchange capacity (c.e.c. 1.1 cmol+/kg) and low in organic matter (0.4% organic carbon); pH_{Ca} 4.2 @ 12 cm, rising to 5.6 @ 22 cm; non saline and non-sodic; sets very hard when dry and turns to slush when wet

55 cm

grey clay with red and yellow mottles; structureless, dense;

softens when wet; poorly drained; weakly sodic at depth, ESP 5-6%; pH_{Ca} 5.8, becomes more acidic at depth;

old decayed tree root @ 65 - 90 cm

Depth	EC	pH CaCl2	pH H20	Colwell P	PBI + Col P	Organic Carbon (W-B)	Chloride	Total Nitrogen	Sulfur (KCl-40)
cm	dS/m	units	units	mg/kg	L/kg	%	mg/kg	%	mg/kg
LOR	0.01	0.04	0.04	2	4	0.05	1.5	0.02	1
0-8	0.26	4.7	5.2	87	41	2	6.4	0.19	30
8-16	0.06	4.2	5	NT	NT	0.39	2.3	0.029	19
18-28	0.04	5.6	6.2	NT	NT	0.4	2.2	<0.02	20
28-37	0.05	6.1	6.5	NT	NT	0.3	3.3	<0.02	22
45-53	0.1	5.8	6.5	NT	NT	0.22	19	0.021	46
64-74	0.06	5.4	6.2	NT	NT	0.19	56	<0.02	9.4
86-90	0.07	5.2	6	NT	NT	0.11	68	<0.02	3

Depth	Al	Ca	K	Mg	Na	CEC
cm	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg
LOR	0.1	0.1	0.05	0.03	0.1	
0-8	0.12	4.5	0.4	1.1	<0.1	6.1
8-16	0.39	0.72	0.26	0.49	<0.1	1.9
18-28	<0.1	0.59	0.1	0.41	<0.1	1.1
28-37	<0.1	0.48	<0.05	0.34	<0.1	0.8
45-53	<0.1	5.8	0.27	4.4	0.54	11.0
64-74	<0.1	4	0.28	4.8	0.46	9.5
86-90	<0.1	2.8	0.27	5.1	0.49	8.7

Wambanumba silty loam chemical properties – cations by compulsive exchange

ICP element scan – hot acid digest (USEPA 3050B)

Depth	Al	As	B	Ca	Cd	Co	Cr	Cu	Fe	K
cm	%	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	%	%
LOR>	0	1	1.2	0.0001	1	1	1	1	1E-04	0.0003
0-8	0.3	1	3.6	0.087	<1	3.1	7.2	13	0.52	0.057
8-16	0.26	<1	1.4	0.019	<1	2.2	6.3	2	0.39	0.047
18-28	0.14	<1	<1.2	0.016	<1	<1	4.2	<1	0.18	0.041
28-37	0.14	1.2	<1.2	0.014	<1	<1	5.1	<1	0.67	0.041
45-53	2.6	2.2	1.9	0.12	<1	3.3	27	13	2.6	0.17
64-74	2.6	2.6	1.6	0.076	<1	2.6	24	10	2.8	0.18
86-90	2.5	6.3	1.3	0.058	<1	13	47	13	5.4	0.17

Depth	Mg	Mn	Mo	Na	Ni	P	Pb	S	Se	Zn
cm	%	mg/kg	mg/kg	%	mg/kg	%	mg/kg	%	mg/kg	mg/kg
LOR>	0	1	1	0.0001	1	0.0004	1	0.0003	1	1
0-8	0.03	390	<1	0.0019	2.3	0.028	5.9	0.019	<1	10
8-16	0.02	290	<1	0.0015	1.7	0.0074	5	0.0062	<1	6.7
18-28	0.01	22	<1	0.0042	1.4	0.0026	3.5	0.0025	<1	2.2
28-37	0.01	16	<1	0.0059	1.2	0.0027	4.7	0.0025	<1	1.8
45-53	0.14	54	<1	0.015	9.6	0.0067	13	0.0084	<1	18
64-74	0.16	44	<1	0.013	9	0.016	11	0.0021	1.2	19
86-90	0.16	320	<1	0.014	9.5	0.03	22	0.0017	3.3	18

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