

SOIL SERIES IN THE NATAL SUGAR BELT

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During the years 1955 to 1961 the Experiment Station at Mount Edgecombe carried out a field by field soil survey of the industry, covering in all some 748,000 acres, on a scale of 1 in 6,000 (1 inch = 500 feet).

Prior to embarking upon this survey, a considerable amount of research on Natal Coastal soils had already been carried out, and as a result of that research it had been clearly established that there was a close relationship between the soil and the parent rock from which it was derived. Consequently it was decided that the most logical way of grouping the soils would be on the basis of the underlying geology. In this survey, seventeen groups and sub-groups were mapped on this basis.

An additional feature which soil research had brought to light was that within each geological soil group there were a number of variations in the character of the soil profile. These variations were traceable to the influence of actual variation in the parent material itself, to topography, climate and to other factors. Despite the fact that these inter-group variations were appreciated prior to the survey, it was nevertheless decided that only a broad group or sub-group survey should be carried out, and without delay.

There were various advantages in doing this. In the first place a soil series survey was rather too elaborate and involved for the facilities at hand. Secondly, it was appreciated that a soil group survey would render much simpler a subsequent series survey, since knowledge of the whereabouts of the broader groups would give direct evidence of the whereabouts of the finer variations. Thus, for example, a knowledge of the whereabouts of Table Mountain sandstone soils, eliminated the possibility of the numerous non-Table Mountain sandstone profiles occurring within those limits already mapped. A third reason for pressing on with the group survey was that the industry was very much in need of some definition of its soils and broad definitions were speedier to obtain and possibly more understandable by those who did not have the opportunity to devote a great deal of their time to this study. A fourth reason was that a group survey would provide information on the soils and thereby permit a far more efficient series survey at a later date. In actuality that is what took place, for during the five years of soil group survey a great number of test pits were examined and information collected over those years has given rise to the formulation of 37 soil series, though none of these soil series has actually yet been mapped. Most of these observations, together with supporting analytical data, have been presented in the three volumes published on the soils of the South Coast, North Coast and Zululand.

Soil Series

It is on account of differences in soil profile that soil scientists the world over have an earnest desire

to classify or group soil profiles. Such soil profiles are obviously of importance to those concerned with the soil. Any planter, for example, in the course of tilling his soil must have become aware of a hidden danger in concealed stony layers or in hard pan layers. He must also have become aware that these under-surface layers vary from point to point in a field, sometimes even appearing at the surface due to erosion. In other fields he may also have found that although the soil appears uniform, there are areas where drainage is impeded and the soil becomes waterlogged. Quite obviously then, the layers of different kinds of material under the surface are of great importance in agriculture.

An awareness of the importance of these layers prompted the United States to set about a mammoth scheme to map soils on the basis of profile characteristics. In this scheme the categories of series, types and phases were recognised. The most important of these field units, the soil series, was defined as "*a group of soils having horizons (layers) similar as to differentiating characteristics and arrangement in the soil profile and developed from a particular parent material*". In other words, a number of soils with similar or nearly similar profiles were grouped together to form a *series*.

This classification or grouping of soils into series, pioneered in the United States (where several thousand series are now established), has since been extended to many other countries. In recent years it has been extended to parts of Africa, progress being slow since work of this nature is only initiated where important land development and utilisation projects are contemplated or in progress. In Swaziland, soil series classification has reached an advanced and efficient stage and is assisting in the development of that country.

In Natal, a soil series survey of the Tugela Basin (11,000 sq. miles) is nearing completion, while similar surveys are contemplated for the Illovo, Umgeni and Umvoti river basins. A further survey is being carried out by the Cedera College of Agriculture of the soils of the Natal Midlands. Dr. R. F. Loxton of the Department of Agricultural Technical Services, Pretoria, is at present engaged upon the series mapping of various selected areas in South Africa, and it is his intention to extend these surveys as much as possible. In addition his department intends to issue a register of described soil series to obviate duplication in the naming of soil series throughout the country.

The registration of soil series is rendered possible by giving a geographical name (usually where it is first described) to the soil series and adhering to that name wherever a similar profile is subsequently found. Attached to this name is the textural designation based upon the mechanical composition of the surface soil. This latter designation constitutes the soil 'type'. Thus there are in this industry

Williamson fine sandy loam, Milkwood Kraal clayey loam, Lytton coarse sand, etc.

Soil Series of the Sugar-Belt

As indicated earlier, thirty-seven named soil series have so far been recorded for the soils occurring within the industry, most of which have already been described. It does not appear likely that many further series will be established since, where possible,

minor variations are accounted for by the use of 'phases'. Thus we have the Williamson series (shallow phase, or stony phase), Milkwood Kraal series (deep phase) etc.

The following table outlines the geological soil groups already mapped, the soil series known to occur but not yet mapped in each group, and a brief description of the main recognisable features.

Geological Soil Group	Soil Series	Brief Description
Pre-granite quartzite	Humberdale	Moderately deep profile. Surface soil greyish loamy coarse sand of single grained structure and loose to partly friable consistency. Profile becomes slightly compact and cemented with depth. All horizons are acid in reaction. <i>Soil Type: Humberdale loamy coarse sand.</i>
Amphibolite	Dansland	Rather deep profile. Surface soil blackish clay loam of granular to nutty structure and rather friable consistency. Becomes more compact with depth, the profile remaining acid throughout all horizons. <i>Soil Type: Dansland clayey loam.</i>
Tugela schist	Glendale	Moderately deep profile. Surface soil reddish brown loam to clayey loam of granular to coarse nutty structure and friable to compact consistency, becoming compact with depth. Acid to moderately acid throughout the profile. <i>Soil Type: Glendale clayey loam.</i>
	Logoza	Very deep profile. Surface soil reddish brown loam to clayey loam of granular to nutty structure with friable to compact consistency. The profile is rather uniform and acid to moderately acid throughout. <i>Soil Type: Logoza clayey loam.</i>
Granite	Glen Rosa	Rather shallow profile. Surface soil light greyish brown gritty loam, crumby structure and friable consistency. Becomes rather cemented lower down profile with much coarse grit. All horizons are acid. <i>Soil Type: Glen Rosa gritty loam.</i>
	Mayo	Moderately deep profile. Surface soil very dark greyish coarse gritty loam of crumby to granular structure and friable consistency. Profile tends to become cemented with depth, and remains acid throughout. <i>Soil Type: Mayo gritty loam.</i>
	Eldorado	Rather shallow profile. Surface soil light grey coarse sandy to gritty loam of crumby structure and loose to partly friable consistency. Profile becomes slightly compact with depth and is acid throughout. <i>Soil Type: Eldorado fine gritty loam.</i>
Table Mountain sandstone	Cartref	Moderately deep profile. Surface soil light pinkish grey coarse sandy loam of single grained to crumby structure and loose to friable consistency. The profile is rather uniform and acid in all horizons. <i>Soil Type: Cartref coarse sandy loam.</i>
	Trevanian	Moderately deep profile. Surface soil greyish brown coarse sandy loam of crumby structure and friable to slightly compact consistency. This series is transitional between Cartref and Inanda, the profile being also acid throughout. <i>Soil Type: Trevanian coarse sandy loam.</i>
	Clifton	Moderately deep profile. Surface soil light grey coarse sandy loam of single grained to crumby structure and loose to friable consistency. The profile is rather uniform and grades with depth into weathering transported sandstone boulders. The profile is acid throughout. <i>Soil Type: Clifton coarse sandy loam.</i>
	Inanda	Deep profile. Surface soil reddish brown to dark brown loam to clayey loam of crumby structure and friable consistency. Organic matter is very high and all horizons are strongly acid. <i>Soil Type: Inanda clayey loam.</i>
	Solferino	Deep profile. Surface soil greyish brown coarse sandy loam of crumby structure and friable consistency. This series occurs in semi-waterlogged areas and the lower horizons tend plastic and sticky. <i>Soil Type: Solferino coarse sandy loam.</i>

Geological Soil Group	Soil Series	Brief Description
Dwyka tillite	Williamson	Rather shallow profile. Surface soil dark grey fine sandy loam of crumby structure and friable to slightly cemented consistency, becoming very compact with depth. Slightly acid but alkaline below rubble horizon. <i>Soil Type:</i> Williamson fine sandy loam.
	Waldene	Rather deep profile. Surface soil dark grey brown fine sandy loam of crumby structure and friable consistency. Invariably an ironstone gravel layer is present lower down, the profile being moderately acid to begin with but strongly alkaline below. <i>Soil Type:</i> Waldene fine sandy loam.
Lower Ecca shale	Milkwood Kraal	Rather shallow profile. Surface soil dark grey brown loam to clayey loam of crumby to nutty structure and slightly compact consistency. Abundant rubble is present, much of it in the surface soil. The profile is moderately acid, but alkaline below. <i>Soil Types:</i> Milkwood Kraal rubbly loam. Milkwood Kraal clayey loam.
	Phoenix	Deep profile. Surface soil rather dark grey brown to blackish clayey loam of crumby to nutty structure and friable consistency. The profile tends to become plastic with depth and rather alkaline. Some transported soil may constitute surface horizon. <i>Soil Type:</i> Phoenix clayey loam.
Middle Ecca sediments	Mt. Edgcombe	Rather deep profile. Surface soil dark grey brown sandy loam to loam of crumby structure and friable to slightly cemented consistency. The ironstone gravel layer is usually conspicuous lower down. The pH value above this layer being acid but strongly alkaline below. <i>Soil Types:</i> Mt. Edgcombe loam. Mt. Edgcombe sandy loam.
	Avoca	Rather deep profile. Surface soil greyish coarse sandy loam of single grained to crumby structure and loose to friable consistency. The profile is uniform and usually acid throughout. <i>Soil Type:</i> Avoca coarse sandy loam.
	Windermere	Fairly deep profile. Very dark grey brown clayey loam surface soil of crumby to nutty structure and friable to compact consistency. The profile becomes very compact with depth and moderately alkaline lower down in the profile. <i>Soil Type:</i> Windermere clayey loam.
Beaufort sediments	Nyoka	Moderately shallow profile. Surface soil light greyish brown loamy fine sand of crumby structure and friable consistency, frequently with ironstone gravel or rubble occurring lower down. The surface is acid, but becomes alkaline in the weathering sediment below. <i>Soil Type:</i> Nyoka loamy fine sand.
	Confluence	Rather deep profile. Surface soil light greyish brown, loamy fine sand of crumby structure and friable consistency. Ironstone gravel and rubble is invariable present as a lower defined layer, while the well weathered parent material contains abundant lime concretions. This soil is particularly liable to brak. <i>Soil Type:</i> Confluence loamy fine sand.
Stormberg sediments	Pogela	Rather shallow profile. Surface soil light greyish coarse sandy loam of crumby structure and friable consistency. The profile which is generally acid, terminates abruptly on the underlying rock. <i>Soil Type:</i> Pogela coarse sandy loam.
Karoo dolerite and Stormberg basalt	Shortlands	Very deep profile. Surface soil reddish or chocolate clay loam to loamy clay of granular to nutty structure and friable to slightly compact consistency. The profile is very uniform throughout and moderately acid in reaction. <i>Soil Type:</i> Shortlands clayey loam.
	Rydal Vale	Moderately deep profile. Surface soil dark grey brown to blackish loam to clayey loam of granular to nutty structure and friable to compact consistency. Ironstone gravel occurs lower in the profile with alkalinity below. <i>Soil Types:</i> Rydal Vale loamy clay. Rydal Vale clayey loam.
	Effingham	Moderately deep profile. Surface soil dark grey brown loam of crumby structure and friable consistency. The profile which is acid is developed from a contaminated dolerite. <i>Soil Type:</i> Effingham loam.
	Sprinz	Very deep profile. Surface soil reddish brown, clay loam of crumby to granular structure and friable consistency, tending to be plastic lower in the profile. The soil reaction is markedly acid with a high accumulation of organic matter. <i>Soil Type:</i> Sprinz clayey loam.

Geological Soil Group	Soil Series	Brief Description
Cretaceous sediments	Haig	Rather shallow profile. Surface soil dark brown to blackish clay loam of granular to nutty structure and friable to compact consistency. The slightly acid surface soil becomes rather alkaline with depth. <i>Soil Type:</i> Haig clayey loam.
	Greens Island	Moderately deep profile. Surface soil dark grey brown sandy loam to loam. The surface soil is acid, but profile becomes alkaline with depth.
	Lake View	Moderately deep profile. Surface soil reddish or chocolate clay loam to loam of granular to nutty structure and friable to slightly compact consistency. The profile is fairly uniform, the soil ending abruptly on hard Cretaceous sediments. The surface soil is neutral, becoming alkaline with depth. <i>Soil Type:</i> Lake View clay loam.
Recent Sands (red)	Clansthal	Very deep profile. Surface soil light reddish brown coarse sand of single grained structure and loose consistency. The profile which is acid often passes into reddish sandy clay near the base. <i>Soil Types:</i> Clansthal coarse sand. Clansthal sandy loam.
	Lytton	Very deep profile. Surface soil reddish brown coarse sand of single grained structure and loose consistency. Profile which is acid, passes abruptly into and is featured by reddish sandy clay well up the profile. <i>Soil Types:</i> Lytton coarse sand. Lytton sandy loam. Lytton coarse sandy clay.
Recent Sands (Grey)	Fernwood	Very deep profile. Surface soil light greyish coarse sand of single grained structure and loose consistency. Profile which is acid, may pass into clayey sand lower down, but is usually sandy throughout. <i>Soil Types:</i> Fernwood coarse sand. Fernwood fine sand.
	Warrington	Deep profile. Surface soil rather greyish to grey brown coarse sand of single grained structure and loose consistency. The profile which is rather acid, is featured well down the profile by a yellowish grey sandy clay. <i>Soil Types:</i> Warrington coarse sand. Warrington fine sand.
Alluvium	Blackburn	Deep profile. Surface soil dark brown loam of crumby structure and rather friable consistency. Profile is featured by alternating layers of sand, clay loam, etc., and is usually neutral to alkaline throughout. <i>Soil Types:</i> Blackburn coarse sand. Blackburn silty loam. Blackburn clayey loam.
	Sinkwazi	Deep profile. Surface soil very dark grey brown silty or clayey loam of crumby to nutty structure and friable to slightly compact consistency. The profile which is usually acid, becomes rather plastic and sticky with depth. <i>Soil Types:</i> Sinkwazi clayey loam. Sinkwazi silty clay.
	Shorrocks Hill	Deep profile. Surface soil reddish brown loam of crumby structure and friable consistency. The profile which is acid to neutral occurs mostly in semi-arid river valleys often overlying pebbles or boulders. <i>Soil Types:</i> Shorrocks Hill loam. Shorrocks Hill clayey loam.
	Mposa	Deep profile. Surface soil brownish black to blackish peat loam of variable structure but rather friable consistency. Profile is strongly acid and particularly high in undecomposed plant residues. Water table often near surface. <i>Soil Type:</i> Mposa peat loam.

Advantages of a knowledge of Soil Series

From the foregoing, it is evident that the soil series classification takes into consideration the whole soil profile, down to six feet or the weathering rock if this is encountered at a depth less than six feet. Genetic processes take place below the surface, giving rise to varying horizons of chemical and physical depletion in one case and accumulation in another.

While it is true that the medium of plant growth is mainly in the surface horizon and that fertilizers placed there have a large effect in determining plant growth, lower horizons do in many cases have a far-reaching effect. As mentioned earlier, the percolation rate, which is a function of the second and even third horizons of a profile, is of great importance in irrigation. Furthermore, impervious second horizons can have a stifling effect and frequently respond to deep subsoiling.

The study of crops in relation to soil series is still in its infancy in the sugar belt. It is not unlikely that further research will indicate that sugarcane behaves differently on different soil series, other factors being equal. In fact there is every indication that such is the case, in which event accumulated knowledge of sugarcane performance and reaction to treatment on a particular series can be extended to all instances where that series occurs. Since the soil profile is the ultimate and complete unit of soil classification, very exact and rewarding methods of improving our crop efficiency are provided by a series survey.

This information existing in the hands of agronomists, could be conveyed to planters who would have their estate map of the distribution of series, and could apply the scientific knowledge in a far more enlightened and practical manner.

That this transference of information is not mere wishful thinking, is illustrated by the fact that in the United States a large part of the agricultural programme is geared to, and in a large measure dependent upon, knowledge of soil profiles derived from soil series surveys.

In the Natal coastal region a series survey would consist in a further breaking down or refinement of the already mapped geological soil groups. One of the difficulties of such a survey, apart from its magnitude, would be the necessity to avoid its becoming weighed down by a mass of minor variations in soil profiles, which would yield a bewildering mosaic rather than an intelligible map. A clear perspective is required during such a survey in order to be able to recognise the minor and unimportant variations and determine the embracing series to which they belong.

The newly completed soil group survey already appears to be having its uses in agricultural research within the industry. These uses will no doubt become increasingly apparent with time, mainly in broadly defining the soils on which experiments are being carried out. How much more useful will our

agricultural experimentation become when we can refer it to the complete and ultimate unit of soil classification, the profile.

South African Sugar Association,
Experiment Station,
MOUNT EDGECOMBE
Natal.
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Dr. Shuker said he hoped the authors were not adopting the American system of soil nomenclature entirely, because a soil known by one name in Mississippi could be called quite another name in other states. He asked if the authors were collaborating with others doing soil survey in South Africa so as to avoid similar confusion.

Dr. Beater replied that a complete register of soil series was now being kept in Pretoria, and correspondence was now being held with the Soils Research Institute there to establish uniformity in nomenclature.

Mr. du Toit asked where a line was drawn between different series and was there not a merging of series?

Dr. Beater said chemical and mechanical analyses were done before deciding on a name. One had to judge from the areas of the different soil types in a field which one predominated, and the field was classified according to the type which occupied the greatest area. It was quite impossible to take into consideration every minor variation.

Mr. Maud said intermediate types could not be classified without making a system unwieldy.

Mr. du Toit asked if a grower could differentiate between the various soil types as the authors knew them now.

Mr. Maud replied that from the soil map the grower could realise that he had, say, a Table Mountain sandstone soil. He then knew for instance if it were in the Mist-belt or not, if it were water-logged or not, and so on. The classification had been made on apparent properties which were readily ascertainable.

Mr. de Robillard asked if the use of a sub-soiler in an Ecca shale would not tend to cause loss of irrigation water.

Mr. G. D. Thompson said that a Nadi plough at Illovo had brought up the shale, but this had weathered in four months and had provided more soil than the field had before and cane had been successfully grown in it.

Mr. Grice stated that deep subsoiling in shale tended after heavy rain or irrigation to cause much of the fertilizer applied on the surface to be leached down and become unavailable to the cane. The tendency now was therefore to avoid deep subsoiling in shale.

Mr. J. Wilson, in the chair, pointed out that there was a difference between subsoiling and ploughing. In ploughing to such a depth that one reversed the profile, one increased the soil depth and presumably

increased the capacity of the soil to hold fertilizer, whereas merely breaking up the parent rock was in fact opening it up, and thus allowing the fertilizer to be leached away.

Mr. Rault said that in Mauritius the Island was mapped according to the proportion of rock present. It was marvellous to see how good cane was grown between rocks. He wondered if a map could be drawn up to show the proportion of rock in South African sugar land.

Dr. Beater pointed out that in Mauritius there was a shortage of land and since a similar problem did not occur here, there were few if any rocky areas under cane. In any case, rocky (lava) areas in Mauritius were associated with very fertile "fossil" soils.

Mr. Main related that some years ago when flying over parts of Zululand, one could see green land which was European owned and when one saw rocks and mountains this was occupied by Bantu. This was thought at first to be unfair until it was pointed out that the green areas were where malaria and nagana had made it impossible for the Bantu to live. European development had eliminated the diseases from these moist areas and made them habitable.

Mr. Maud stated that there was a greater diversity of soil types in the South African sugar belt than was found in other sugarcane areas. The variation in our soils was due to the great amount of faulting in past ages, resulting in the large number of parent rocks being brought next to one another.

Mr. Wyatt said he had seen the work on this subject done over many years in America, and as the authors had followed the American system closely, he thought the amount of work done here in such a short time most commendable. He asked if it were possible to publish a less technical description of each profile which would be more readily understood by growers.

Dr. Beater and **Mr. Maud** related that colour photographs were being prepared which, together with full descriptions, should make the profiles more readily identifiable.

Mr. W. J. G. Barnes considered simplification unnecessary as he found it quite easy to follow the descriptions as now published.

The Chairman said this very creditable initial classification of our soils should be followed up as this would lead to better land utilisation. It reflected great credit on the Industry in its sanctioning and subsidising the work done, as well as paying for the publication of the results.