CHARACTERISTICS OF SOME WATTLE SOILS

By G. D. DARBY

The South African Wattle Industry is located along the 3 to 4 thousand feet contour from the south of Natal to the Melmoth district in Zululand with an outlier around Piet Retief in the Eastern Transvaal.

The total acreage under wattles is approximately 800,000 and the industry is served by nine extract factories.

The main product is wattle bark tanning extract and the by-product is the timber which is used as mine-props, fencing poles and fire-wood and as a raw material for the production of A-cellulose, hard-boards, paper pulp and flooring boards.

As yet no use has been found for the thousands of tons of spent bark which must be promptly burned in the furnaces.

Seeds of the wattle tree (*Acacia Mearnsii*) were brought from New South Wales in 1864 by John Vanderplank, a London merchant, and planted at Camperdown. At that time the wattles were valued as ornamental trees, shelter belts and a source of fire-wood. It was not until 1886 that samples of bark were sent to London for trial as a tanning material. The industry got off to a modest start but by 1904 14,000 tons of stick bark were exported and the area under wattles in Natal was 30,000 acres.

It may be noted here that wattle bark is a good example of a storehouse of Nature since nearly 50% of its solid weight is tannin.

The First World War boosted the industry and in 1916 an extract factory was erected in Pietermaritzburg. Solid extract was then exported instead of bulky stick bark and in that year the export figure was 439 tons which stands in contrast with the 1964 tonnage of nearly 80 thousand.

A very high demand for tanning materials was experienced after the Second World War but when supplies of leather substitutes appeared on the scene the demand for tannin suffered a fall which, happily, has since been halted, and now the position is stabilised. However, the erratic behaviour of the tanning extract market, along with the imposition of bark quotas prompted many wattle growers to diversify and acreages of eucalypts, pinetrees, phormium tenax and sugar cane were extended or introduced.

Vegetation, Topography and Climate

Before wattles were established the land was covered with veld grasses which are thought to be a fire-climax vegetation.

The topography is rolling country with a tendency for the altitude to drop from 4 to 3 thousand feet in a S.E. direction.

The climate consists of an annual rainfall of 840 mm. (35 inches), the greater part of which falls during the warm summer months, a mean temperature of 60° F. to 65° F. (15°c-18°c) with the absence of extremes and the frequent occurrence of mist.

Soils

Wattle soils generally are residual from the weathering of the underlying geological formations which consist of Table Mountain sandstone, Dwyka tillite, Ecca shales and sandstones and intrusive dolerite.

Description of a Representative Wattle Soil

This soil is derived from T.M.S. in the Seven Oaks district of the Natal Midlands which is in the heart of the Wattle Belt.

The soil is more than ten feet deep overlying soft, decomposed rock. The top 10-15 inches is reddish brown to chocolate in colour merging into a red soil often with a yellow hue, which gradually becomes darker red until the colour of the parent rock predominates.

There are always concretions of iron and manganese where the dark organic-rich top-soil gives way to the yellowish red horizon. There are often small pockets of white kaolinite matter throughout the sub-soil, but there are never concretions of calcium or magnesium carbonate.

Throughout the profile the structure is columnar.

The predominant red colour indicates that the soil is freely drained, thus three conditions for good arable land are satisfied; they are free drainage, adequate root-room and moisture during the growing season. The fourth condition is an adequate supply of plant nutrients, about which there will be more later.

Chemical and Physical Investigation

The following results were obtained for a sample of top soil:

pH	5.58
C%	3.67
N%	0.30
C/N	12.2
Exchangeable Ca me%	2.50
Exchangeable Mg me%	1.50
Exchangeable Na me%	0.04
Exchangeable K me%	0.36
Exchangeable Bases me%	4.40
Cation exchange capacity me%	12.00
Readily extracted phosphate (P_2O_5) ppm	12
Available Nitrogen (N) ppm (Cornfield's method)	115
Coarse sand %	44
Fine sand %	32
Silt %	4
Clay %	20
	100

The clay fraction was investigated by Dr. M. E. Sumner and the following results were obtained:

Montmorillorite — abundant
Kaolinite — slight
Gibbsite — trace

Discussion of Results

The results show that the soil is rather acid and very poorly endowed with available plant nutrients. The values for Ca, Mg, K and P_2O_5 are low but total nitrogen and organic matter are fairly high due to the considerable build-up of litter from the leguminous wattle.

It has been found that the top-soil of wattle plantations of 30 or more years' standing has approximately 50% more N than has neighbouring veld top-soil. In the case of the soil analysed, the neighbouring veld would be expected to have about 0.20% N and the increase in percentage of 0.10 is equivalent to the nitrogen in approximately 6,000 lb. urea.

A point of interest is that the soils of the Natal Mist Belt are among the few in South Africa in which organic matter can be built up under conditions of free drainage.

Taking both the description and the analysis into consideration it can be concluded that the representative wattle soil is good for both agriculture and forestry, always assuming that the correct nutrient status is maintained.

The Value of Wattle Soils

The last sentence implies that wattle soils are general purpose soils.

Extensive wattle plantations in Natal and Zululand have given good yields of tannin-rich bark for many decades and, in a number of cases, without the application of fertilisers; superphosphate being the only fertiliser used for commercial plantations.

Regarding supers, an interesting finding is that an application of 360 lb. superphosphate per acre gave an increase of 55% of bark. 360 lb. supers contains about 72 lb. P_2O_5 and the top 9 inches of that particular acre contained approximately 10,000 lb. P_2O_5. Almost all the phosphate in the soil is chemically combined with Al and Fe constituents in a form difficultly available to plants.

The value of wattle soils to sugar cane is an important subject in view of the relatively large acreage already diverted from wattle to cane. The writer's experience with cane has been obtained from some seven year old cane fields at Paddock and Plains in South Natal and from new plantings at Seven Oaks. Little can be said about the latter save that the young cane gives promise and that neighbouring farmers have had several excellent crops.

At Paddock a fertiliser experiment laid down in 1958 on land recently under wattles has to date given the following results:

Variety N:Co.376

	Plant	*1st Ratoon*	*2nd Ratoon*
Age at cutting (months)	22	24	23½
Rainfall total (inches)	96	83	84
Rainy days, total	193	199	200
Rainfall, 1.10-31.3	59	60	66
Rainy days, 1.10-31.3	140	146	159
Average yield per acre			
(tons)	51.4	55.6	63.1
per month	2.3	2.3	2.7
per inch rain	0.54	0.67	0.75

The soil is a very nutrient deficient sand of about 2 feet in depth overlying quartzitic beds of T.M.S. It is quite different from the T.M.S. soil of Seven Oaks and the area was taken out of wattles because of the uneconomical bark yields.

Of importance is the increase in yield of cane per acre from plant to the second ratoon which may be due to the progressively more favourable climatic conditions, since both the summer rainfall values and the number of rainy days, total and summer, increased during the same period of time.

The results of the experiment showed that there was no response to N by the plant and the first ratoon but a significant response by the second ratoon, probably due to the gradual decomposition of the N-rich wattle litter.

There were responses to P and K by both plant and ratoons.

The healthy state of the cane at all times suggests that there are as yet no minor element problems.

The cane never benefited from applications of lime.

The results of the experiment showed the necessity of applying fertilisers and the following amounts are now in use on the Company's cane fields.

	N	*P*	*K*
Plant cane In furrow	19	60	—
Top dressing	23	—	200
	42	60	200
As urea, supers and muriate	90	680	400
Ratoons Top dressing	138	17.6	300
As urea, supers and muriate	300	200	600

Acknowledgements

The identification of the clay minerals by Dr. M. E. Sumner of the Faculty of Agriculture, University of Natal.

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Advice concerning cane cultivation by Mount Edgecombe Sugar Research Station.

Summary

Wattle soils in general are deep, freely drained, acid, poorly endowed with plant nutrients except nitrogen and are suitable for both agriculture and forestry.

After several rotations of wattles the total nitrogen and organic matter values are high.

These soils hold distinct promise for the cultivation of sugar cane assuming that the need for plant nutrients is recognised.

Literature

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Mr. Thompson: The findings on high altitude soils at Illovo confirm Dr. Darby's figures, particularly in respect of phosphorus and potassium. On the Cartref series in the Wartburg area a response to nitrogen was obtained only from a plant crop, but on a Trevanian series at Powerscourt we applied all forms of phosphate and got a response of ten tons per acre in the plant and in the first ratoon, the soil having a pH of 4.6, indicating that cane, like the wattle, can tolerate a low pH.

For potassium, on the same series, the response was twenty-two tons per acre in the plant for an application of two hundred pounds and exactly the same response in the first ratoon.

On an Inanda series, which had been under cane for some time at Powerscourt, from eighty tons of filter cake placed in the furrow, we got a twenty tons cane per acre response.

There was one anomaly when we had a fertilizer trial at Wartburg on a doleritic intrusion, immediately after wattles. There was absolutely no response to N, P or K, but during the growth of the crop we could see the strips where the wattle brush had been burnt.

Dr. Darby: This problem has been a puzzle for many years, as the same effect is found in wattle, that where the brushwood has been burnt the wattle comes up very rapidly. It is a combination of many circumstances, immediately available phosphate being possibly the most important factor.

Mr. Johnson: Can Dr. Darby explain how the pH was determined and was the readily available phosphate carried out with an acid or alkaline extractant?

Dr. Darby: 20 gm. of soil were shaken with 100 cc. of water and the pH taken the following morning.

One litre of 0.05 normal solution of sulphuric acid extracted 50 g. of air dried surface soil.

Mr. Gosnell: Having had experience of growing crops such as maize, sunflower and pyrethrum after wattle in Kenya, I can confirm some of Dr. Darby's observations. In the first two years after wattle, no response was obtained to nitrogen but thereafter a response was obtained. After burning of brushwood we noticed appreciable increase in calcium, magnesium, sulphur and phosphate in the soil.