TRENDS IN CANE AND SUGAR YIELDS IN NATAL

By J. L. DU TOIT.

The phenomenal increase in consumption of sugar in South Africa, coupled with a cycle of years of deficient rainfall, have turned our pre-war sugar surplus problem into one of acute shortage for the domestic market. The eyes of the general public are focussed on the sugar industry and its efficiency, and imaginary causes for this unprecedented scarcity of our commodity are often heard. Fortunately, the record of achievement of the sugar industry bears examination.

F. Maxwell,[2] "Economic Aspects of Cane Sugar Production," 1927, stated: "So far no statistics are available on this subject [yields of cane and sugar per acre], but from personal experience of the writer and fragmentary information, it would appear that a broad average of 18 to 20 tons of cane per acre over an extended cycle of years may be taken. Of course, in the alluvial flats of Zululand, a crop of 40 tons per acre and higher is met with in the case of virgin cane and early ratoons; but, on the other hand, on partially exhausted soils of Natal and the sandy hills of Zululand, crops of 15 tons or lower are not rare.

Since at present in Natal and Zululand an average of about 11 tons of cane is required to make a ton of "raw" (cargo) sugar, the yield of sugar will be usually less than two tons per acre; as a broad average it may be taken that the yield is at present slightly less than one ton per acre per annum."

There is no fault to be found with this estimate of yields for that period; in fact, statistics that are available from 1922 confirm these figures. The "partially exhausted" soils seem to be a misnomer, however, but can be excused because it offered an explanation for the low yields then obtained. Since then, partly and largely through the introduction of new varieties, the yield has been increased to over 30 tons of cane per acre and some of the oldest cane-producing districts, such as Inanda, have averaged 40 tons of cane per acre over 20,000 acres harvested. The lack of statistics is now no longer a serious drawback, for annual returns are available for the whole industry. These may not be absolutely accurate as far as individual returns from farmers are concerned, but provided averages are taken it is possible to get a clear picture of the trend in production, which has been stepped up in a most spectacular manner.

Critics of the industry, however, still try to find the cause of the sugar famine in "partially exhausted" or by now surely completely depleted soils of the industry, and agriculturists who know more about agricultural practices in general than the sugar industry in particular try to find the reason in monoculture. They maintain that if not the whole area, then certainly parts thereof—for example, the South Coast—show unmistakable signs of such deterioration, and the introduction of new and better varieties may temporarily lead to better yields but cannot alter the basic fact that the productivity is on the decline as a result of bad agricultural practice.

It is therefore necessary to summarise in some detail the results obtained over the last twenty and more years and to examine in how far the new varieties have been responsible for increases in yields, and whether their introduction has obscured a general downward tendency which would have taken place if Uba had still been grown. The constituent areas of the industry, e.g. South Coast, North Coast and Zululand, will be dealt with individually to find an explanation for differences in yields.

Method.

The annual yields of sugarcane per acre are summarised yearly in our Proceedings; the yield per acre of Uba and non-Uba is given, and it is generally found that non-Uba outyields the old variety by about 50 per cent. This figure is, however, not reliable as a comparison between varieties, because to start with only plant cane and first ratoons non-Uba varieties were compared with the total Uba yield, including older and lower yielding ratoons; whereas in later years the average of older ratoons has increased in the new varieties, but Uba is now represented almost exclusively by third, fourth and older ratoons. In this paper, however, the relative merits of Uba compared with non-Uba varieties as a group will be calculated as the arithmetic average of all comparable yields in plant cane and the various ratoons separately. These comparisons can be combined in proportion to the various ratoons cut, giving finally one figure indicating the relative yield of non-Uba expressed as a percentage of the Uba yield.

It will further be possible to compare the general trend of yields within the same variety over a number of years. In the case of Uba, second, third and fourth ratoons will be taken, because older ratoon yields are not always comparable and the amount of Uba plant cane in the latter years is so small that yields are not always reliable. For non-Uba, however, plant cane will be taken, because the data are obtainable over the longest period in this case.

TABLE 1.

Yield of Cane per Acre, 1922-44, for Natal and Zululand.

Year.	Variety.	Plant.	1st ratoon.	2nd ratoon.	3rd ratoon.	4th ratoon.	Other ratoons.	Area reaped.	Total tons harvested.	Yield in tons per acre
1922-23	Uba	—	—	—	—	—	—	79,759	1,578,801	19.8
1923-24	Uba	—	—	—	—	—	—	90,429	1,917,874	21.2
	Other varieties	—	—	—	—	—	—	38	686	18.1
	Total	—	—	—	—	—	—	90,467	1,918,560	21.2
1924-25	Uba	—	—	—	—	—	—	86,538	1,614,129	18.7
	Other varieties	—	—	—	—	—	—	93	2,081	22.4
	Total	—	—	—	—	—	—	86,631	1,616,210	18.7
1925-26	Uba	—	—	—	—	—	—	102,041	2,309,411	22.6
	Other varieties	—	—	—	—	—	—	72	1,882	16.5
	Total	—	—	—	—	—	—	102,113	2,311,293	22.6
1926-27	Uba	—	—	—	—	—	—	106,803	2,182,623	20.4
1927-28	Uba	21.1	19.6	18.3	15.8	16.3	18.2	70,474	1,338,669	19.0
1928-29	Uba	21.9	21.4	18.9	17.6	17.0	18.4	88,846	1,780,113	20.0
1929-30	Uba	23.0	22.0	19.4	18.3	18.8	17.8	134,857	2,797,888	20.7
1930-31	Uba	24.5	23.9	21.2	19.4	19.8	19.7	144,874	3,243,107	22.4
1931-32	Uba	20.2	20.1	17.5	15.9	18.2	18.7	139,774	2,635,728	18.9
1932-33	Uba	22.1	20.3	18.1	16.1	16.6	18.3	163,584	3,155,195	19.3
	Non-Uba ..	27.4	29.4	—	—	—	—	41	1,140	27.8
	Total	22.1	20.3	18.1	16.1	16.6	18.3	163,625	3,156,335	19.3
1933-34	Uba	22.3	21.1	18.7	18.3	18.1	20.0	161,268	3,261,490	20.2
	Non-Uba ..	29.2	31.6	—	—	—	—	309	9,113	29.5
	Total	22.4	21.1	18.7	18.3	18.1	20.0	161,577	3,270,603	20.2
1934-35	Uba	24.6	22.0	19.2	17.8	17.9	18.1	168,410	3,475,001	20.6
	Non-Uba ..	29.5	31.4	20.7	—	—	—	4,037	119,297	29.6
	Total	25.0	22.1	19.2	17.8	17.9	18.1	172,447	3,594,298	20.8
1935-36	Uba	22.0	21.9	18.4	16.8	16.9	16.5	161,111	3,139,633	19.5
	Non-Uba ..	27.3	23.1	25.3	30.0	—	—	14,781	395,851	26.8
	Total	23.4	21.9	18.5	16.8	16.9	16.5	175,892	3,535,484	20.1
1936-37	Uba	20.5	21.6	19.0	17.1	17.2*	16.3	127,556	2,428,235	19.0
	Non-Uba ..	27.6	23.9	23.2	29.7	44.7*	—	51,432	1,379,676	26.8
	Total	26.2	22.1	19.2	17.2	17.2	16.3	178,988	3,807,911	21.3
1937-38	Uba	21.6	23.2	20.2	19.2	17.4	18.1	103,949	2,118,070	20.4
	Non-Uba ..	30.8	25.4	24.0	22.5	28.7	25.2	67,886	1,962,893	28.9
	Total	29.5	24.1	20.7	19.3	17.6	18.1	171,835	4,080,963	23.7
1938-39	Uba	23.6	21.6	21.8	19.1	18.3	19.2	58,181	1,186,900	20.4
	Non-Uba ..	34.0	29.6	27.8	25.6	32.9	18.1	96,483	3,045,976	31.6
	Total	33.4	28.0	24.0	20.0	19.4	19.2	154,664	4,232,876	27.4
1939-40	Uba	27.0	26.6	24.9	22.4	22.7	19.1	52,060	1,215,111	23.3
	Non-Uba ..	37.3	32.4	28.8	26.5	28.0	28.5	108,228	3,629,157	33.5
	Total	36.9	31.8	26.9	23.5	23.2	19.3	160,288	4,844,268	30.2
1940-41	Uba	26.7	23.2	22.8	21.6	18.3	19.1	44,168	925,164	21.0
	Non-Uba ..	34.8	30.1	26.0	23.8	24.5	24.0	129,963	3,872,064	29.8
	Total	34.7	29.6	25.2	22.5	19.7	19.5	174,131	4,797,228	27.5
1941-42	Uba	22.1	20.2	17.2	15.3	14.9	13.0	31,062	472,623	15.2
	Non-Uba ..	28.7	24.4	21.7	20.1	21.0	22.1	130,065	3,129,766	24.1
	Total	28.6	24.3	21.2	18.2	17.2	14.4	161,127	3,602,389	22.4
1942-43	Uba	23.1	24.3	20.2	17.2	17.0	15.9	22,186	383,468	17.3
	Non-Uba ..	31.8	27.0	24.2	21.8	24.3	21.8	145,144	3,882,210	26.8
	Total	31.7	27.0	23.9	21.0	20.4	17.6	167,330	4,265,678	25.5
1943-44	Uba	27.4	28.6	22.6	21.1	19.6	16.9	11,019	215,687	19.6
	Non-Uba ..	37.1	32.1	28.4	26.2	24.6	26.8	145,963	4,629,686	31.7
	Total	37.0	32.0	28.2	25.7	22.8	21.1	156,982	4,845,373	30.9
1944-45	Uba	28.6	24.1	21.5	20.1	19.8	19.0	6,687	133,311	19.9
	Non-Uba ..	33.4	31.1	27.0	24.7	25.4	24.9	161,748	4,765,069	29.5
	Total	33.4	31.1	26.9	24.6	24.4	22.5	168,435	4,898,380	29.1
Arithmetic average of comparable yields ..	Uba ..	24.0	23.0	20.7	19.0	18.5	17.5	—	—	—
	Non-Uba	31.5	28.6	25.2	25.1	26.2	23.9	—	—	—
	Non-Uba % Uba	131.3	124.3	121.7	132.1	141.6	136.6	—	—	—

* Not included in average.

The graphs given will summarise these results, and a five-year moving average will be used to illustrate general trends better and to eliminate as far as possible climatic factors influencing the yields in any one year.

The yield data, compiled from the "Special Census of Sugarcane Plantations" issued annually by the Union Government Office of Census and Statistics, may be considered quite reliable taken over large areas or over a number of years; but individual returns are certainly open to question and, in fact, a few results obtained over very small areas have been left out in the Uba and non-Uba comparison as being unreliable. This, however, will not affect the general conclusions of this paper, which are based on a very large amount of data. It will be obvious though that these deductions cannot be made on the results of any individual year, or even on a summary of results over a few years.

Yield Data for the Whole Industry.

In Table 1 the yield of Uba and non-Uba varieties is given in detail for the whole industry. It will be noticed that the records from 1922-1926 are incomplete, particulars about plant cane and ratoons not being given. In 1927 and 1928 there appears to be a drop in the total area cut, but this is due to lower number of returns, supplying all the data, being received. From 1929, however, the records are again complete. The statistical data only apply to European-owned cane lands, but Indian and Native planters were included in the 1922-23 season's returns. The negligible quantity of cane other than Uba harvested in 1923-25 is included, although it does not affect the average results.

It will be seen that the yield of cane has increased to about 30 tons per acre. The average yield for 1939 was 30.2 tons per acre and the average for the last two years under consideration 30.0 tons per acre, in spite of 1944 being affected by drought and the small proportion of Uba still harvested also tending to lower the average somewhat. The rainfall distribution in 1940 was very bad, and it was followed by the disastrous drought of 1941, when only 26.18 inches of rain were recorded as the average for the industry, and the crop of the following year was consequently also affected. The yield of cane per acre in normal years has therefore increased by about 50 per cent. —from 20 to 30 tons per acre. The new varieties have, however, not outyielded Uba to this extent. Only in the case of fourth ratoons is the non-Uba per cent. Uba yield as high as 141.6 per cent., and Table 2 shows that only a small proportion of fourth ratoons is cut. Taking into account the various proportions, plant and ratoon canes cut from 1927-44 in Table 2 and computing the average superiority of the new varieties over Uba, we find that if Uba had been completely replaced by the new varieties, which is not yet the case, an approximate increase in production of 29 per cent. could be expected. There must, therefore, be reasons other than the introduction of new varieties to account for part of the increase. A possible explanation may be that more plant and early ratoons are now cut than in the past. Table 2 shows that this is not the case. In fact, the proportion of plant and first ratoons cut during the last five years under review is somewhat less than the average for 1927-44 or for the five years ending 1933. More second, third and fourth ratoons are now cut than before, but the amount of later ratoons has fallen.

TABLE 2.

Plant and Ratoons Harvested in Natal and Zululand as a Percentage of the Total Area Harvested.

Year.	Variety.	Plant.	1st ratoon.	2nd ratoon.	3rd ratoon.	4th ratoon.	Other ratoons.
1927-44	All varieties	27.5	24.4	21.6	14.1	6.2	6.2
1929-33	All varieties	27.5	24.3	21.5	13.6	5.7	7.4
1940-44	All varieties.	26.2	23.6	23.2	15.4	6.5	5.2

A careful examination of Table 1 points to the fact that, quite apart from the introduction of new varieties, there has been an increase in the yield of Uba and non-Uba varieties within the same ratoon, reflecting an apparent increase in the productivity of the sugar lands. This is illustrated more clearly by reference to Table 3, where moving averages of yields of second, third and fourth ratoons for Uba and of plant cane for non-Uba varieties are given. In graph No. 1 this increase in productivity is clearly shown. The second, third and fourth ratoons of Uba have here been combined in the respective average proportions of these ratoons harvested from 1927-44.

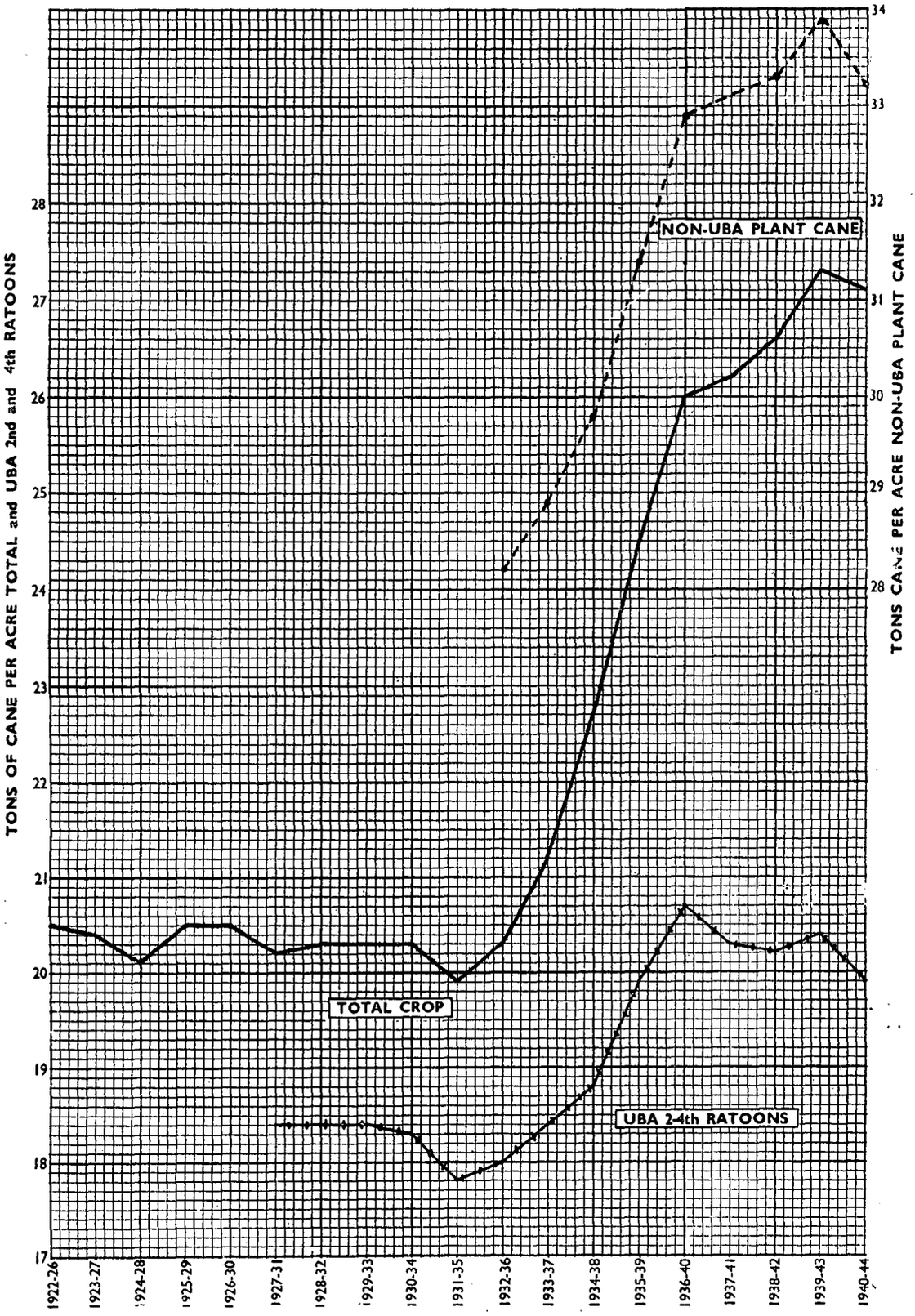
TABLE 3.

Five-year Arithmetic Averages of Cane Yields in Tons per Acre for Natal and Zululand.

Year.	Total crop.	Uba 2nd ratoons.	Uba 3rd ratoons.	Uba 4th ratoons.	Non-Uba Plant.
1922-26 ..	20.5	—	—	—	—
1923-27 ..	20.4	—	—	—	—
1924-28 ..	20.1	—	—	—	—
1925-29 ..	20.5	—	—	—	—
1926-30 ..	20.5	—	—	—	—
1927-31 ..	20.2	19.1	17.4	18.0	—
1928-32 ..	20.3	19.0	17.5	18.1	—
1929-33 ..	20.3	19.0	17.6	18.3	—
1930-34 ..	20.3	18.9	17.5	18.1	—
1931-35 ..	19.9	18.4	17.0	17.5	—
1932-36 ..	20.3	18.7	17.2	17.3	28.2
1933-37 ..	21.2	19.1	17.8	17.5	28.9
1934-38 ..	22.7	19.7	18.0	17.5	29.8
1935-39 ..	24.5	20.9	18.9	18.5	31.4
1936-40 ..	26.0	21.7	19.9	18.8	32.9
1937-41 ..	26.2	21.4	19.5	18.3	33.1
1938-42 ..	26.6	21.4	19.1	18.2	33.3
1939-43 ..	27.3	21.5	19.5	18.5	33.9
1940-44 ..	27.1	20.9	19.1	17.9	33.2

Graph No. 1

TONS CANE PER ACRE FOR NATAL AND ZULULAND



It is clear, therefore, that the increase in yield of cane per acre over the whole sugar belt is mainly due to the introduction of new varieties, but not entirely. There is no evidence whatsoever of the soil becoming exhausted or depleted and consequently not being able to maintain production at a given level. On the contrary, there is definite evidence that increased production is partly due to better yields now being obtained than in the past from the same varieties and of the same age.

Zululand.

The average yields of cane per acre for Zululand (north of the Tugela) from 1939 to 1944 were respectively 30.5, 28.9, 24.6, 26.1, 31.3 and 29.1 tons of cane per acre, or very similar to the yield of the whole industry. Zululand suffered from the same droughts, though not to the same extent, during some of these years as the other parts of the industry. In the case of Zululand the yield per acre was appreciably higher in 1922 to 1930 than the average for the industry; but after that very low yields were recorded until 1937. These trends are best illustrated in Table 4 and graphically shown in graph No. 2. After an initial

TABLE 4.

Five-year Arithmetic Averages of Cane Yields in Tons per Acre for Zululand.

Year.	Total crop.	Uba 2nd ratoons.	Uba 3rd ratoons.	Uba 4th ratoons.	Non-Uba Plant.
1922-26 ..	23.3	—	—	—	—
1923-27 ..	23.0	—	—	—	—
1924-28 ..	22.7	—	—	—	—
1925-29 ..	22.8	—	—	—	—
1926-30 ..	21.9	—	—	—	—
1927-31 ..	20.7	19.4	18.2	19.5	—
1928-32 ..	20.1	18.6	17.8	18.3	—
1929-33 ..	19.6	18.1	17.4	17.7	—
1930-34 ..	19.1	17.5	16.6	17.4	—
1931-35 ..	18.2	16.5	15.8	16.2	—
1932-36 ..	18.7	16.8	16.0	16.3	28.9
1933-37 ..	20.1	17.0	16.7	16.9	28.9
1934-38 ..	22.2	17.4	17.1	17.1	29.9
1935-39 ..	24.7	18.4	18.1	17.5	31.8
1936-40 ..	26.8	19.8	18.6	18.0	33.2
1937-41 ..	27.7	19.4	18.0	16.9	33.5
1938-42 ..	27.9	19.2	17.2	16.6	32.9
1939-43 ..	28.3	19.1	17.2	16.2	33.3
1940-44 ..	28.0	19.5	16.5	16.5	32.8

downward trend, total yields have increased since 1937 at a much faster rate than for the industry as a whole. Although soil productivity has apparently increased since that date (the Uba curves being upwards as well as that for non-Uba plant cane), the main reason for this is the excellent results obtained from non-Uba varieties. Where it was found that for the entire industry non-Uba outyielded Uba by about 29 per cent., the calculated figure for Zululand is 47 per cent. The new varieties, therefore, seem to be particularly well suited for Zululand and their superiority over Uba is evident in all districts, but especially so in the Hlabisa and Umfolozi divisions.

TABLE 5.

Plant and Ratoons Harvested in Zululand as a Percentage of the Total Area Harvested.

Year.	Variety.	Plant.	1st ratoon.	2nd ratoon.	3rd ratoon.	4th ratoon.	Other ratoons.
1927-44	All varieties	30.1	25.3	21.8	13.2	4.6	5.1
1929-33	All varieties	29.8	23.9	20.9	12.9	4.8	7.8
1940-44	All varieties	28.5	25.6	24.1	13.6	5.0	3.1

Although some very old ratoons may be found in Zululand, on the average a lower proportion of third, fourth and older ratoons is cut here than is the practice for the rest of the industry (see Table 5 and 2.) This practice of not allowing the average cane to run to too many ratoons also tends to keep the production in this area at a high level.

North Coast.

The North Coast (area between the Umgeni and Tugela Rivers) is one of the oldest cane-growing areas in the sugar industry—the first commercial cane planting having been started here just about 100 years ago. It is certainly much older than the Zululand area and the effects of monoculture should be quite evident here. Instead of finding a falling rate of production, the average yields have gone up in a most astounding manner. It is now the highest yielding area in the cane belt, whereas it was decidedly poorer than Zululand at the beginning of the period now under review. The average yield from 1922 to 1928 was less than 19 tons per acre, and from 1939-44 an average yield of 29.7 has been recorded, which would have been appreciably greater were it not for unfavourable climatic conditions during three of the six years. The average yield of the last two years is 33.1 tons per acre. Table 6 and graph No. 2 show the average improvements that have taken place. The introduction of the new varieties, although largely responsible for the increase in total yields per acre, does not contribute to this as much as it does in Zululand. Whereas it was estimated that the new varieties were capable of yielding 47 per cent. more than Uba in Zululand, the figure for the North Coast is only 23 per cent., so that a large part of the increase must be attributed to the increased fertility of the land or to better agricultural practices being followed, etc. The yield of Uba second ratoons was 18.3 tons per acre in 1927-31, and in recent years the averages recorded were over 22 and 23 tons per acre. The same increases are evident from Table 6 in other ratoons and non-Uba plant cane averaged 28.3 tons per acre in 1932-36 and 37.4 tons per acre for the period 1939-43.

Graph No. 2

TONS CANE PER ACRE FOR ZULULAND, NORTH COAST AND SOUTH COAST

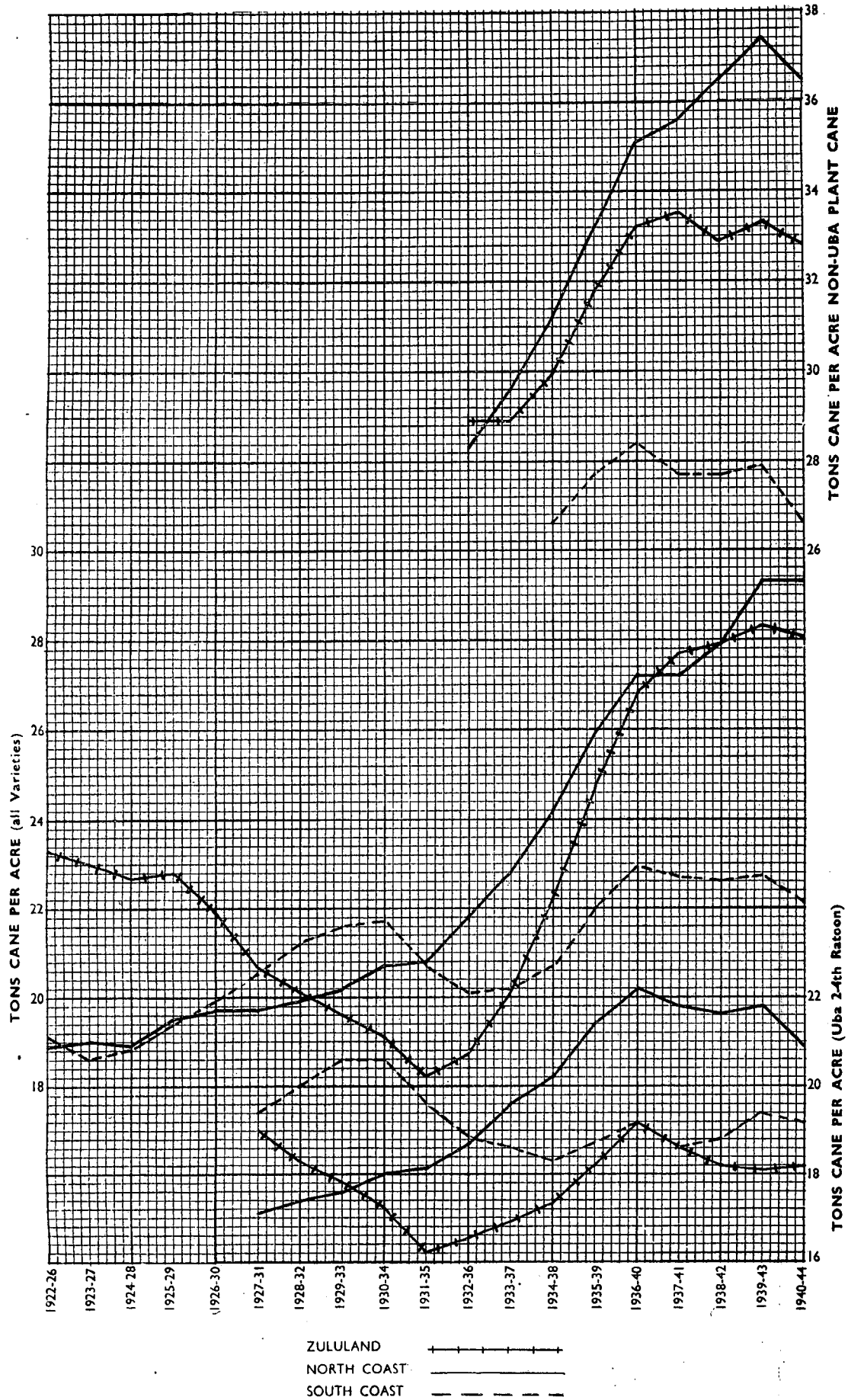


TABLE 6.

Five-year Arithmetic Averages of Cane Yields in Tons per Acre for the North Coast.

Year.	Total crop.	Uba 2nd ratoons.	Uba 3rd ratoons.	Uba 4th ratoons.	Non-Uba Plant.
1922-26 ..	18.9	—	—	—	—
1923-27 ..	19.0	—	—	—	—
1924-28 ..	18.9	—	—	—	—
1925-29 ..	19.5	—	—	—	—
1926-30 ..	19.7	—	—	—	—
1927-31 ..	19.7	18.3	16.0	15.2	—
1928-32 ..	19.9	18.5	16.2	15.9	—
1929-33 ..	20.2	18.6	16.4	16.5	—
1930-34 ..	20.7	19.0	16.9	16.5	—
1931-35 ..	20.8	19.0	17.0	16.9	—
1932-36 ..	21.8	19.7	17.7	17.2	28.3
1933-37 ..	22.8	20.6	18.7	17.9	29.6
1934-38 ..	24.2	21.5	19.0	18.1	31.2
1935-39 ..	25.9	22.6	20.1	20.0	33.2
1936-40 ..	27.2	23.5	20.9	20.1	35.1
1937-41 ..	27.2	23.0	20.7	19.6	35.6
1938-42 ..	27.9	22.9	20.4	19.5	36.5
1939-43 ..	29.3	23.1	20.5	19.7	37.4
1940-44 ..	29.3	22.4	19.5	18.4	36.5

Natal Estates, in the Inanda district, of course, practices irrigation on a large scale, and this is certainly a contributing factor in ensuring such excellent returns, but its influence on the whole of the North Coast must not be overestimated.

Hill-Lewis[1] points out that the estates under irrigation at Natal Estates have increased production from 18.7 tons per acre before the commencement of irrigation to 38.59 in 1941-45, but there was also an increase of from 21.3 to 36.3 tons cane per acre or over 70 per cent. in the corresponding periods on sections where no irrigation was applied—an increase obtained without the aid of irrigation and too large to be attributed to the introduction of new varieties by themselves. The author further states that 11,000 acres are under irrigation, only half of which, of course, will be cut yearly; but the average acreage cut on the North Coast during the last five years under review is more than 67,000. The irrigated sections of Natal Estates therefore only represent about 8 per cent. of the total area. Even allowing for some irrigation in other parts, it will be clear that this cause can only contribute a small proportion to the general progress that has been made. Furthermore, the Lower Tugela area by itself reflects a similar picture of increased production per acre.

The fact is therefore inescapable that on the North Coast nothing has happened to make the soil incapable of yielding the same quantity of cane per acre as it did more than twenty years ago, and what is more, by careful management far better yields are now obtained from the same varieties than before. Soil fertility as reflected by soil productivity is on the increase and definitely not on the decrease.

Table 7 shows that on the North Coast a slightly higher proportion of third and fourth ratoons is cut than is the case in Zululand, and apparently these have increased still further in recent years. On the whole, however, the percentages of plant and ratoon canes cut have not changed appreciably in this area and do not differ from the averages of the industry or Zululand by any great amount.

TABLE 7.

Plant and Ratoons Harvested on the North Coast as a Percentage of the Total Area Harvested.

Year.	Variety.	Plant.	1st ratoon.	2nd ratoon.	3rd ratoon.	4th ratoon.	Other ratoons
1927-44	All varieties	28.1	25.9	23.0	14.5	5.4	3.0
1929-33	All varieties	28.4	26.0	23.6	14.4	4.6	3.0
1940-44	All varieties	27.3	24.0	22.9	16.4	6.2	3.2

South Coast.

The South Coast (the area south of the Umgeni) is the section of the industry most often singled out for attack. Here it is considered soil deterioration has gone so far that reasonably good yields can no longer be obtained. Reference to Table 8 will show that better total yields are now obtained than in the past, but a glance at the corresponding tables for Zululand and the North Coast certainly reveals the fact that the production rate of the South Coast has lagged considerably behind the other sections in recent years. There was little difference in the yields between the South Coast and the North Coast at the beginning of the period under review, but during the last number of years the North Coast has produced from 5 to 7 tons of cane per acre more than the South Coast. Zululand started off with an advantage of about 4 tons per acre but went down to considerably below the South Coast production, but it has since taken the lead over the latter area again by 5 to 6 tons per acre.

It is unfortunate that the South Coast has had the effect of lowering our average yields per acre somewhat, but this in itself does not, of course, constitute proof of the contention that the soils of the South Coast are exhausted, or that it cannot in future compete with the other sections. In the first place, the South Coast was relatively more favoured than the other two areas for some years following 1929, when our rainfall records began, and has consequently produced some fairly good yields; but during recent years it has suffered more from drought conditions than Zululand and the North Coast and the effect has been to lower the yields obtained. Table 8 and graph No. 2, however, do not show any signs of the actual yields going down, although the steady increase in productivity remarked on in the case of the North Coast and the progress shown in Zululand since about 1937 is not so evident here. Apart from the peak period following 1928, however, the rate of

yield for the same ratoons in the case of Uba or plant cane for the new varieties has been almost constant, which is very creditable considering the severe droughts suffered in this area in 1940, 1941 and 1944.

TABLE 8.

Five-year Arithmetic Averages of Cane Yields in Tons per Acre for the South Coast.

Year.	Total crop.	Uba 2nd ratoons.	Uba 3rd ratoons.	Uba 4th ratoons.	Non-Uba Plant.
1922-26 ..	19.1	—	—	—	—
1923-27 ..	18.6	—	—	—	—
1924-28 ..	18.8	—	—	—	—
1925-29 ..	19.4	—	—	—	—
1926-30 ..	19.9	—	—	—	—
1927-31 ..	20.5	19.9	19.1	18.8	—
1928-32 ..	21.2	20.6	19.4	19.6	—
1929-33 ..	21.6	21.1	20.1	20.3	—
1930-34 ..	21.7	21.4	19.9	20.1	—
1931-35 ..	20.7	20.5	18.8	19.0	—
1932-36 ..	20.1	19.9	18.3	18.1	—
1933-37 ..	20.2	19.4	18.2	17.5	—
1934-38 ..	20.7	19.3	17.8	17.0	26.6
1935-39 ..	22.0	20.0	18.0	17.4	27.7
1936-40 ..	22.9	20.1	19.1	17.7	28.4
1937-41 ..	22.7	19.5	18.3	17.4	27.7
1938-42 ..	22.6	20.3	17.9	17.3	27.7
1939-43 ..	22.7	20.3	19.5	17.7	27.9
1940-44 ..	22.1	18.6	21.1	17.6	26.6

If actual soil fertility has not decreased and the level of productivity has been maintained within the varieties, why then have the total yields not gone up more now that the new varieties have nearly completely replaced Uba? If we try to arrive at a measure of the superiority of the new varieties over Uba along the same lines as before, i.e. averaging all comparable Uba and non-Uba yields in plant cane and the various ratoons and obtaining an average of these by taking into consideration the various percentages of plant cane and ratoon cane cut in this section, we find that the new varieties outyield Uba by only about 17 per cent. It is therefore clear that production increase cannot be expected to equal that of Zululand and the North Coast, where the comparable figures amount to 47 and 23 per cent. respectively. These percentages must be accepted as approximations only; but there can be no doubt that the new varieties have exerted their greatest influence in Zululand in raising the tons cane per acre, and that on the South Coast their effect has been small compared with the other two centres.

Graph No. 2 further shows clearly that although the average yield of cane per acre of all varieties has been appreciably higher in Zululand than on the South Coast and the yield of new varieties plant cane on the South Coast is at a much lower level than in Zululand, still, as far as Uba is concerned, the South Coast yields compare very favourably with those of Zululand. In fact, as can be seen from graph No. 2, they are higher in every 5-year period except two, in which the yields were identical. The difference in the average yields per acre between the two centres is therefore mainly due to the new varieties yielding so much better in Zululand than on the South Coast.

One rather unsatisfactory feature about the South Coast is the high proportion of old ratoons cut, as shown in Table 9. At least one-fifth of the total acreage cut annually is fourth and older ratoons, while both in Zululand and on the North Coast only about 10 per cent. of fourth and older ratoons is harvested. It will, therefore, be possible to increase the yield per acre somewhat on the South Coast by not allowing the cane to ratoon quite so long.

TABLE 9.

Plant and Ratoons Harvested on the South Coast as a Percentage of the Total Area Harvested.

Year.	Variety.	Plant.	1st ratoon.	2nd ratoon.	3rd ratoon.	4th ratoon.	Other ratoons.
1927-44	All varieties	22.8	20.4	18.9	15.0	9.8	13.1
1929-33	All varieties	22.3	21.9	19.0	13.3	9.3	14.2
1940-44	All varieties	21.1	20.0	22.3	16.3	8.9	11.4

Sucrose Per Cent. Cane.

When the new varieties were released, it was fully expected that with their cultivation a general rise in sucrose per cent. cane in the industry could be expected, because all the major new varieties now grown were considered higher in sucrose content than Uba. Moberly[3], in summarising the results obtained by the Central Board Cane Testing Services on about 60 per cent. of the total cane supplied to mills, found that Uba had the lowest sucrose content with the doubtful exception of Co.290, which is decidedly higher in sucrose content than Uba if a Java Ratio of 2.0 in its favour is applied. On a common Java Ratio there is little difference in sucrose between the two varieties.

The following table gives the results of comparable tests done at the Experiment Station :—

	Uba.	P.O.J.2725.	Uba.	Co.281.
No. of comparisons	173	173	196	196
Av. sucrose % cane	13.32	15.48	13.53	14.96
	Uba.	Co.301.	Uba.	Co.290.
No. of comparisons	31	31	213	213
Av. sucrose % cane	13.62	14.57	13.56	14.46

The sucrose contents of Uba in these tests do not vary very much, and if we take the average sucrose per cent. cane for Uba and adjust the other percentages accordingly we get the following :—

	Uba.	P.O.J. 2725.	Co.281.	Co.301.	Co.290.
Sucrose per cent. cane	13.51	15.70	14.94	14.45	14.41

All the evidence points to an increase in sucrose content for the industry with the replacement of Uba, and the extent to which it has been replaced is shown in Table 10, but in spite of all this no general increase in sucrose per cent. cane is evident in the industry. During the recent drought years, 1941, 1945 and 1946, new high sucrose levels have certainly been recorded, but these years must be taken as exceptions. It is difficult to explain why a general increase has not taken place, especially where varietal differences have largely persisted as shown in the paper by Moberly. An increase in trash and extraneous matter would, however, result in a general lowering of sucrose levels. If now the three sections com-

TABLE 10.

Per Cent. of Total Crop.

Variety.	1932.	1934.	1936.	1938.	1939.	1940.	1941.	1942	1943.	1944.	1945.
Uba ..	100.0	96.7	63.8	32.2	30.2	23.2	16.6	11.1	6.5	4.3	2.8
Co.281..	—	—	—	21.0	38.3	37.5	42.4	52.4	64.4	66.5	67.8
Co.290..	—	—	—	35.0	30.0	28.2	26.5	19.1	11.3	7.2	4.4
Co.301..	—	—	—	0.3	2.4	3.3	5.9	10.6	14.1	18.1	21.1
P.O.J.s .	—	—	—	11.3	9.1	7.8	8.6	6.8	3.8	3.8	3.3
Co.331..	—	—	—	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6

prising the industry are analysed separately, we find that in Zululand the sucrose content has remained relatively constant, on the North Coast there has been a slight decrease, but the expected increase is revealed in no uncertain manner on the South Coast. This is shown on Table 11 and graph No. 3, where moving five-year averages of the sucrose content are given. The low sucrose year 1934, caused by heavy locust damage to cane, has been excluded from these averages, and where this year falls within the period averaged, four-year averages were taken. The increase in sucrose content of cane on the South Coast helps to offset the rather low cane yields obtained in this area. Table 12 shows the increases in the production of sucrose in the different areas.

TABLE 11.

Five-year Moving Averages of Sucrose per cent. Cane.

(*Note.*—1934 not included; where this year falls within the period averaged a four-year average is taken.)

Year.	Whole industry.	Zululand.	North Coast.	South Coast.
1926-30 ..	13.45	—	—	—
1927-31 ..	13.57	13.29	13.88	13.25
1928-32 ..	13.54	13.24	13.87	13.20
1929-33 ..	13.56	13.21	13.92	13.25
1930-34 ..	13.72	13.37	14.09	13.37
1931-35 ..	13.71	13.34	14.06	13.40
1932-36 ..	13.58	13.11	13.88	13.45
1933-37 ..	13.69	13.16	13.98	13.64
1934-38 ..	13.63	13.15	13.83	13.75
1935-39 ..	13.58	13.13	13.78	13.70
1936-40 ..	13.49	13.04	13.64	13.76
1937-41 ..	13.63	13.32	13.71	13.92
1938-42 ..	13.53	13.25	13.55	13.90
1939-43 ..	13.43	13.14	13.44	13.85
1940-44 ..	13.48	13.18	13.45	14.02
1941-45 ..	13.70	13.47	13.65	14.19

TABLE 12.

Yields of Tons Sucrose per Acre (Product of Tables 3, 4, 6, and 8 by Table 11.)

Year.	Whole industry.	Zululand.	North Coast.	South Coast.
1926-30 ..	2.77	—	—	—
1927-31 ..	2.74	2.75	2.73	2.72
1928-32 ..	2.75	2.66	2.76	2.80
1929-33 ..	2.75	2.59	2.81	2.86
1930-34 ..	2.79	2.55	2.92	2.90
1931-35 ..	2.73	2.43	2.92	2.77
1932-36 ..	2.76	2.45	3.03	2.70
1933-37 ..	2.90	2.65	3.19	2.76
1934-38 ..	3.09	2.92	3.35	2.84
1935-39 ..	3.33	3.24	3.57	3.01
1936-40 ..	3.51	3.49	3.71	3.15
1937-41 ..	3.57	3.69	3.73	3.16
1938-42 ..	3.60	3.70	3.78	3.14
1939-43 ..	3.67	3.72	3.94	3.14
1940-44 ..	3.65	3.69	3.94	3.10

It is not the object of this paper to deal with the increased efficiencies of the mills, but as it affects the actual output of sugar in the industry, Table 13 is given to illustrate how the tons of sucrose recovered per acre have increased.

TABLE 13.

Yield of Cane per Acre, Sucrose per cent. Cane, Yield of Sucrose per Acre, Overall Recovery, and Tons Sugar 96° Pol. Recovered per Acre.

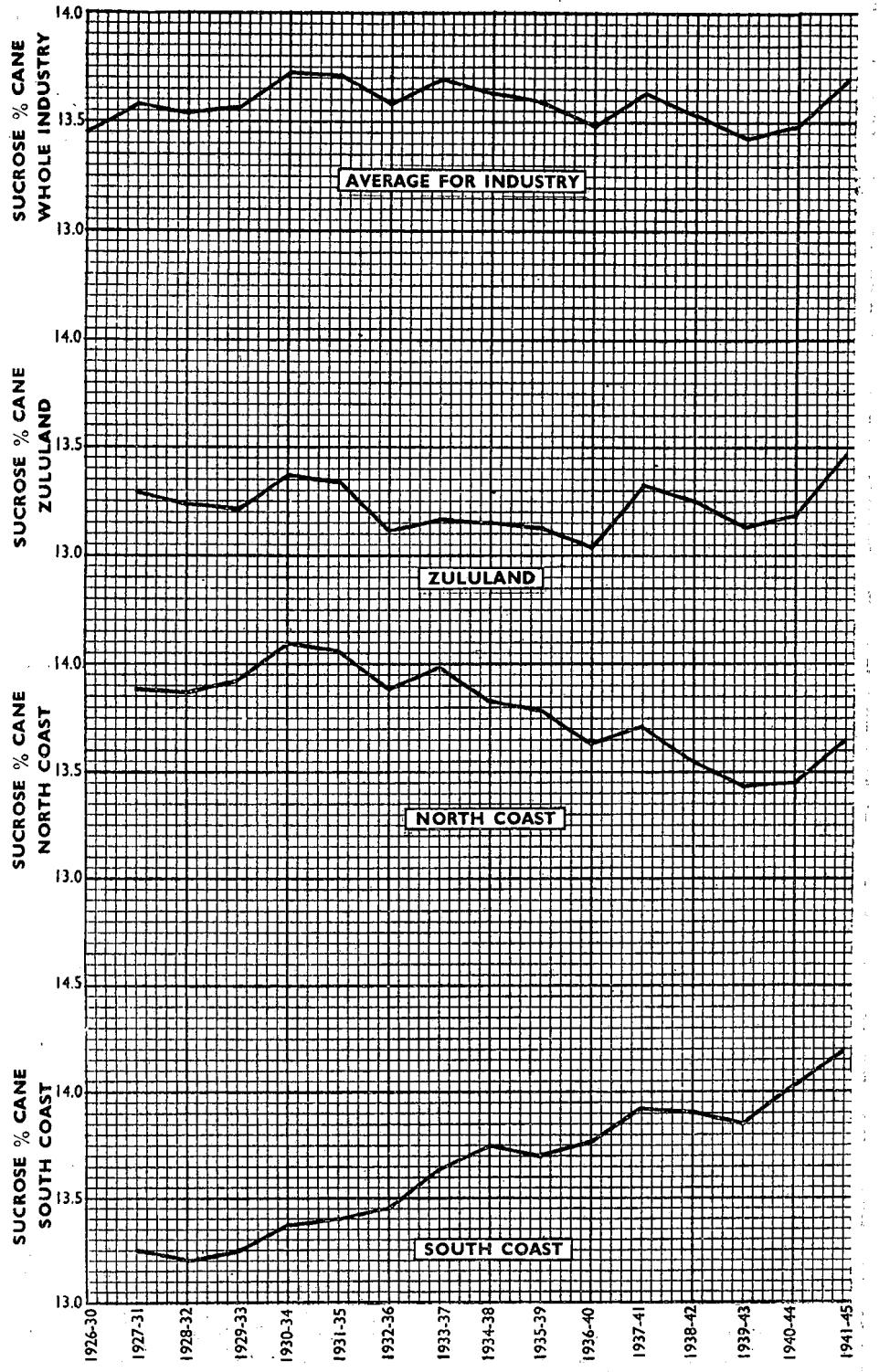
Year.	Cane per acre.	Sucrose per cent. cane.	Yield of sucrose per acre..	Overall recovery.	Tons sugar 96° pol. per acre
1925 ..	22.6	12.55	2.84	73.28	2.17
1926 ..	20.4	13.23	2.70	74.48	2.09
1927 ..	19.0	13.66	2.60	74.13	2.01
1928 ..	20.0	13.75	2.75	75.06	2.15
1929 ..	20.7	12.95	2.68	75.13	2.10
1930 ..	22.4	13.66	3.06	74.77	2.38
1931 ..	18.9	13.84	2.62	74.39	2.03
1932 ..	19.3	13.48	2.60	75.73	2.05
1933 ..	20.2	13.88	2.80	76.63	2.24
1934 ..	20.8	11.88	2.47	77.59	2.00
1935 ..	20.1	13.65	2.74	78.40	2.24
1936 ..	21.3	13.30	2.83	79.64	2.35
1937 ..	23.7	13.92	3.30	80.41	2.76
1938 ..	27.4	13.64	3.74	81.31	3.17
1939 ..	30.2	13.41	4.05	81.98	3.46
1940 ..	27.5	13.19	3.63	80.86	3.06
1941 ..	22.4	14.00	3.14	81.66	2.67
1942 ..	25.5	13.40	3.42	82.48	2.94
1943 ..	30.9	13.14	4.06	83.52	3.53
1944 ..	29.1	13.67	3.98	83.14	3.45

Conclusions.

The yield of cane per acre in the industry is now nearly 50 per cent. higher than it was during the years before the introduction of the new varieties,

Graph No. 3

SUCROSE PER CENT. CANE FOR THE WHOLE INDUSTRY, ZULULAND, NORTH COAST AND SOUTH COAST



which played a most important part in raising the production level. This increase is, however, not entirely due to the new varieties which are now planted to the near exclusion of Uba, for even the yields obtained from Uba where it is still grown are now higher than it used to be. The yields obtained from the new varieties as a group have also increased rapidly but this is due, in part at least, to later introductions outyielding the varieties first released, and a more rational selection of varieties for areas and soil types where experience has shown them to do best. The fact, however, remains that no evidence can be found for the assertion that soils of the sugar belt are getting depleted and therefore no longer capable of producing the same yields for any given variety.

Contrary to expectations, there has not been a general increase in the sucrose content of the cane as now grown in the industry, but the increased yields have ensured a correspondingly greater production of sucrose per acre. The increase in mill efficiencies, which now allows for more than 83 per cent. of the sugar in cane being recovered as compared with about 73 per cent. in 1925, has ensured an even greater increase in the amount of sugar manufactured per acre. About 3½ tons of 96° pol. sugar are now recovered per acre from the two-year cane crop.

The present sugar scarcity in South Africa is therefore not due to exhaustion of the cane lands or lack of increased efficiency in the mills, but is primarily the result of increased demands and a cycle of very dry years.

Zululand, where cane cultivation had started much later than in the other two sections, has profited most from the introduction of the new varieties. Sucrose per cent. cane has not gone up, but the increase in yield as a result of the change over has been more pronounced here than in the other sections. This area has been somewhat more fortunately placed as regards rainfall in recent years than the rest of the industry. In 1926-30 the yield of sucrose per acre was 2.75 tons, and for 1940-44 the average was 3.69 tons sucrose per acre.

On the North Coast the increased production per acre due to the introduction of the new varieties has not been so great as in Zululand, but in addition to this very substantial increase, soil productivity, assisted in certain cases by irrigation, has reached new high levels, and consequently this is now our highest yielding area. The sucrose content of the cane has not gone up; on the contrary, except for some exceptionally dry seasons, the trend has been downwards. Nevertheless, this area has shown the greatest increase in tons sucrose per acre. The yield of sucrose per acre has increased from 2.73 tons in 1926-30 to an average of 3.94 tons in 1940-44.

Even in the case of the South Coast no evidence can be obtained from the yield data that soil deterioration has taken place. Admittedly the yields lag somewhat behind that of the North Coast and Zululand, but Uba still seems to be capable of yielding the same as when our comparisons started. The new varieties are almost entirely responsible for the increased yields now obtained, but they do not outyield Uba by the same margin as in Zululand or even on the North Coast. There is a tendency on the South Coast to cut rather larger proportions of old ratoons than seems warranted, and this also has a depressing effect on the yields. In addition, the South Coast has suffered more during recent years as a result of deficient rainfall than the other areas, and the result is reflected in lower yields. Thus the South Coast had an average rainfall of 41.9 inches in 1929-33, compared with 40.5 inches for Zululand and only 36.4 inches for the North Coast. This period corresponded to a peak in production on the South Coast, especially as compared with the other two areas; but the rainfall averages for 1940-44 are 39.2 inches for the South Coast, 45.6 inches for Zululand and 40.6 inches for the North Coast, and the South Coast has had the lowest rainfall for any consecutive five-year period since 1936. The average sucrose content of cane has, however, been decidedly on the increase in this area and has partly set-off the low cane yields.

Summary.

The yields of cane per acre obtained in Natal have been recorded from 1922 to 1944. The part played by the introduction of new varieties in increasing yields is sketched. By analysing the yields obtained from certain Uba ratoons and non-Uba plant cane, the conclusion arrived at is that there is no falling off of production within the same variety, but that the productivity of the soil has actually increased. The sucrose content of the crops in five-yearly periods is given and remains fairly constant.

The examination covers the respective areas comprising the industry, and the trends in yields of cane and sucrose per acre are given for Zululand, the North Coast and the South Coast.

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Experiment Station,
South African Sugar Association,
Mount Edgecombe.
March, 1947.

The PRESIDENT, in opening the paper for discussion, said that there had been a great deal of confusion with regard to the production of cane and sucrose in Natal, as was clearly shown in a recent article in *Veld Trust News*, which gave an entirely wrong picture of conditions here. This paper now before the Conference gave us trends in cane and sucrose yields in Natal during the last 22 years.

Mr. MOBERLY referred to the fact that, as pointed out in the paper, the new varieties were known to have a higher sucrose content than Uba, but the actual average sucrose per cent. cane had not increased appreciably for the industry by the replacement of Uba by these varieties. There might be other reasons to account for this discrepancy, but he thought that accompanying trash, as indicated by the author, was probably one of the chief reasons. The effect of this trash was not always realized, but even 5 per cent. trash would decrease the sucrose from 15 to 14.3 per cent., and he had known consignments to contain up to 20 per cent. trash and tops. An investigation into the amounts of accompanying trash on cane would be very valuable, for unless we get a measure of extraneous material entering the factory with the cane, it was very difficult to make comparisons.

Dr. HEDLEY thought the paper was an interesting and heroic attempt to analyse conditions in the sugar industry. There was no doubt that the new varieties had greatly improved the yields, and better agricultural methods had also played an important part, but there were so many factors influencing yields and sucrose percentages that it was extremely difficult to correlate them all. There had been a great advance in the knowledge of fertilizer application, but it was almost impossible to get the quantities of fertilizers now used and to compare them with the amounts used before. Other factors known to influence yields and sucrose percentages were rain, sunlight and trash.

Dr. DODDS agreed with Mr. Moberly that a general increase in the percentage of trash was probably the main reason why the expected increase in sucrose per cent. cane did not take place. The increase in fibre per cent. cane, regardless of weather conditions, pointed to the fact that increasing quantities of trash were accompanying the cane to the mills. This also partly explained why samples of cane analysed at the Experiment Station always showed a higher sucrose result than actual factory tests. The cane was sent into the factory with a large amount of trash, and consequently the sucrose percentage was depressed; whereas cane analysed at the Experiment Station had to be cleaned well before analysing, in order to get concordant results from replicated samples.

He was glad to see that the author did not condemn the South Coast, as was so often done, simply because yields were somewhat lower in this section than for the industry as a whole. The recent drought cycle, with the exception of last year, was much more severe on the South Coast than for the other districts. Another reason that accounted for the fact that the South Coast did not keep pace with the rest of the industry in increased yields, was that long fallow was not practised sufficiently. He knew of many examples of the excellent effects of a year's rest from sugarcane.

The author also drew attention to the period of very low yields obtained in Zululand prior to 1937. That, he thought, was due to the severity of streak infection in Uba in that area.

It was very difficult to find out what the consumption of fertilizer was in the industry, as many suppliers were either unwilling or unable to say what quantities were sold to sugar planters. It was certain, however, that, contrary to the general idea that soil fertility was being lost in the sugar industry, it was actually being built up, while the application of green manure crops had a good deal to do with the increased crops in recent years, particularly so during the last few years when there was a serious shortage of artificial fertilizers. During this period great efforts were being made to apply substitute fertilizer materials of all kinds.

Mr. FOWLIE said that the period under review in this paper more or less coincided with his own experience in the sugar industry. When he first began to meet planters he found that very few of them used fertilizers in any large quantities, and those who did mostly used superphosphate only. Practically no nitrogenous fertilizers were used. That policy gradually changed, and with the introduction of new varieties certain fertilizer firms, rightly or wrongly, took up the cry—partly a selling cry—that the new varieties required more fertilizer than the old Uba—and that helped to sell the fertilizer, which proved a very sound investment. He was convinced that the increase in yield that took place from about 1933 or 1934 was just about equally due to fertilizer application and the introduction of new varieties.

Mr. DYMOND felt that the new varieties were largely self-trashing compared with Uba, and he could not agree with the idea now advanced by some speakers that the new varieties had more adhering trash which masked their superior sucrose content. He did not think that the percentage of trash now entering the factories was more than in the days when Uba was grown exclusively.

Mr. LEWIS agreed with Dr. Hedley that the subject raised was important and one with many ramifications. He was satisfied, however, that the paper clearly showed that soil productivity was on the increase, and not on the decrease, in the sugar belt. A comparison between yields and annual rainfall can be very misleading because rainfall distribution was of such importance. A crop might often not benefit at all from unseasonable rainfall, although the effect

might be felt the following season as a result of the raising of the water table.

Green tops might not affect the sucrose per cent. cane to the same extent as trash, but the sucrose extracted from these tops was not readily available.

Cane was generally planted on steep gradings on the South Coast and the soils were often shallow. He wondered whether more leaching took place on the South Coast, and whether the composition of the soils differed from that of the rest of the industry. The application of fertilizers was general, but he thought more research was required to find out whether these applications were always required.

Mr. DU TOIT, in reply, stated that it was quite impossible in a short paper of this nature to deal with all the aspects of cane production and reasons that influenced yields. His main purpose had been, however, to show the general trend and to indicate that, apart from the introduction of new varieties which played such an important part in raising production, there was a residual increase in yields which must be attributed to better agricultural practice and increased fertility of the soil. It was known that more fertilizers were now applied, but the actual quantities could not be obtained and was not essential for the purposes of this paper.

Trash certainly would have a disturbing influence, particularly on sucrose percentages, and that was referred to in the paper; but it would have no effect on the yield of sucrose per acre which was given for the period under review.

The effect of rainfall was stressed by some speakers and it was pointed out that rainfall distribution had to be considered. That was realized in writing the paper, and reference was made to some years of deficient rainfall as well as others which were characterised by bad distribution; but by working with five-year averages, indicating trends and not annual yields, the disturbing influence of rainfall on any one season's returns was not so marked except where we had to deal with an unfavourable cycle of years.

Chemical analyses did not show that the soils of the South Coast were inferior to soils of other areas as a whole, although areas such as the Umfolozi flats were, of course, much more fertile. Apart from chemical analyses of soils, fertilizer field trials were regularly conducted by the Experiment Station on different types of soils, to find out which fertilizers and what quantities were required.

In reply to Mr. Duchenne, the author stated that although in the case of Umfolozi flats the cane was cut before it was two years, the average for Zululand, including the Umfolozi area, was about two years, and all calculations were therefore based on this average, which also applied to others parts of the industry.