# THE IMPORTANCE OF CORRECT APPLICATION OF ADEQUATE FERTILISER

By EXLEY STEWARD

The production of the South Africa Sugar Industry for the current season 1958-59 easily constitutes a record. Although final figures are not available at the time of writing this production will be in the vicinity of 1,132,000 tons of sugar.

There are several reasons for this record production, some of which are, (*a*) an increase in the area harvested, (*b*) cultivation of heavy yielding varieties, (*c*) favourable rainfall, (*d*) larger areas under irrigation, (*e*) increased yield of cane per acre, and (*f*) greater milling facilities. By far the most outstanding reason is the increase in yield of cane per acre. This increase is directly due to the fact that planters have, in the last few years, applied more fertiliser to their fields than was customary in the past. Normal rainfall is, of course, necessary for high yields and although the rainfall for the past two years has been good it is no better than has often been experienced in two successive years in the past. Thus we must attribute the increased yield to the greater applications of fertiliser. Generally speaking it had been the practice to fertilise at the time of planting only, or, in the case of ratoons to top-dress once during the first few months of growth. In fact the belief was held, in some cases, that if a field of cane was planted after having received a green manure crop then sufficient nitrogen had been supplied by the green manure to last the plant cane crop for two years until it was harvested, and that it was unnecessary to supply more. It has now been generally accepted that the application of fertiliser during the first year of growth only is inadequate, and that further applications in the second year are essential to higher yields and greater profits. The fact that this principle has been carried out is, then, the reason for the record production. Twenty-one years ago, in a paper presented to the 12th Annual Congress of this Association in 1938, entitled "The Fertilisation of Ratoon Canes", the writer showed that experiments had proved that lavish applications of fertiliser gave better results and bigger profits.

The fertiliser that had been applied to the experiment then under review was 1,500 lbs. Superphosphate, 1,000 lbs. of Sulphate of Ammonia and 333 lbs. Muriate of Potash per acre. This had been split up and applied in five separate top-dressings over a total period of nine months.

It is essential that the application of fertiliser is made according to the particular requirements of soil concerned, which vary considerably. Today this presents no difficulty as the Fertiliser Advisory Service of the South African Sugar Association furnishes all the information required if soil samples are submitted by the planter. If the advice given is taken, and acted upon, the planter can rest assured that his fertiliser needs are being adequately met. It is interesting to notice that in this country thirty years ago the emphasis was on phosphate, ten years ago on nitrogen and to-day on potash. Tomorrow it may be on trace elements.

A past President of this Association, the late Mr. G. C. Dymond, always maintained that if cane was adequately supplied with all its necessary food requirements in the shape of fertilisers, and provided it was not suffering from any disease, there was no reason why it could not give satisfactory yields indefinitely and there should be no reason to have to plough out and re-plant unless it was desired to grow a different variety. Mr. Dymond was able to prove his theory with an experimental plot of Uba he grew at Darnall which he cultivated up to 10th ratoon with no diminishing of the yield. This theory is being proved correct in field practice to-day where excellent yields are being obtained from 4th and 5th ratoons, with no indication that further ratoons will not still give high yields. In the case of one field of Co.331 harvested at Kearsney last season as 4th ratoon the yield was higher than obtained in any of the previous crops, including the plant cane crop, due solely to adequate fertilisation. The fact that more ratoons can be grown is an obvious advantage as ploughing out and re-planting is an expensive operation.

Having decided to use sufficient amounts of fertiliser the question then arises of when and how to apply to the best advantage. There are many ways of doing this. Let us deal first with plant cane when the fertiliser can either; (*a*) all be put in the furrow with the cane sett; (*b*) a portion put in the furrow at time of planting and the balance top-dressed later, or (*c*) not be used at all when planting but the full amount applied as a top-dressing. It has long been an accepted fact that phosphate should be applied in the furrow at time of planting and that the nitrogen and potash, being soluble, can with advantage be held back and applied as a top-dressing when the young plant is well established, and able to take up the nitrogen and potash immediately, without the fertilisers being exposed to loss by leaching, which can be serious if they are applied at the time of planting immediately before heavy rains. C. D. Sherrard[1] in discussing the application of fertiliser to plant cane states. "The

nitrogen and potash is far better applied as a top-dressing after the cane is established. Should a mixture be used in the furrow at planting time then one with high phosphate and low nitrogen content should be chosen." Good results have been achieved when no fertiliser at all is given at time of planting but all subsequently applied as a top-dressing. This is in fact the standard practice in Barbados and other West Indian Islands. There the fertiliser is not applied until the young cane has started to make foliage. The reasons given for this procedure were that a young cane shoot fed on the parent sett in the initial stages of growth and would not make use of any fertiliser until a root system had been developed; that if fertiliser was applied before it could be taken up by the cane, losses might occur through leaching and through any weed growth, also that there was no danger of the eye becoming damaged through direct contact with the fertiliser.

Although method (*b*) is the one that appeals most, no planter should stop planting operations, when conditions are ideal, just because he may have run out of fertiliser.

The fertiliser can always be applied later with very satisfactory results. When plant cane is to be top-dressed it has been found beneficial to keep all cultivators out of the field so as not to level off the furrows. The top-dressing is put into the furrow and immediately covered up by the first cultivation.

The application of fertilisers to ratoons can be done in many different ways depending on whether the crop has been trashed or burnt and, if trashed, how the trash has been handled, whether it has been left as an undisturbed blanket, or piled into alternate rows, or removed from off the cane roots and piled in every row. In the first instance the fertiliser is often broadcast over the entire trash blanket, in the second case the trash free lines are usually pony-ploughed, the fertiliser put in the resulting furrow and scarified over, and in the third case put on, or alongside, the cane stools. Recently it was felt that the top-dressing would be more beneficial if it was applied below the surface of the ground directly to the roots of the cane and away from immediate contact with shallow rooted weeds. The ratoon crops are usually sub-soiled, particularly in heavy soils and low rainfall areas, to prevent run off during heavy falls of rain and to conserve as much moisture as possible. An experiment was carried out to see whether the fertilisation of the ratoon crop at the same time as the sub-soiling operation would be practicable, and give satisfactory results. This was done by using a hydraulic tool bar on a D2 Caterpillar tractor on to which coulters for cutting through the trash blanket, sub-soiler chisels and fertiliser containers were attached.

The fertiliser was led from the containers down behind the sub-soiler uprights by a pipe with three outlets, the first at the base of the upright, and second six inches higher, followed by the third, another six inches higher. As the sub-soiler works to a depth of eighteen inches a third of the fertiliser is applied at that depth, a third at a depth of twelve inches and a third at a depth of six inches. Figure I shows a D2 tractor with the sub-soiling and fertilising attachments in a raised position as the machine comes to the edge of the field. Two rows at a time are done. The point of the sub-soiler can be seen just behind the bottom of the right hand coulter. Figure II shows the machine in operation and gives a good indication of the thickness of the trash which is successfully cut through by the coulter. The results of this treatment are very gratifying and the ratoons are giving better yields than those that receive their fertiliser on the surface.

In experiments on the deep application of fertiliser to sugar cane, W. H. Patrick, Jr. and B. Sturges[2] state "The placement of at least half of the nitrogen in the sub-soil gave an increase in yield of more than two tons of cane per acre. The placement of nitrogen at the 13 inch depth resulted in the nitrogen being more available during the dry part of the summer when soil at the 3 inch depth was too dry for the crop to absorb nitrogen applied at this depth. The results of this study after three years of experimental work, indicate that increases in yield may be obtained from deep placement of fertiliser and deep tillage in growing seasons where a deficiency of soil water exists and on soils with hardpans or compacted layers that restrict root penetration and water movement. In growing seasons with an ample supply of water these increases in yield may not occur. During seasons with high rainfall, however, no decreases in yield have resulted from deep fertiliser placements. From the results of this study it appears that deep fertiliser placements, or deep tillage, may be of value in years of below average rainfall on soils that are subject to compaction."

The simplest way for the small planter, who may not have a tractor and sub-soiling equipment, to get his top dressing under ground is to pile the trash into every alternate row, pony-plough the trash-free row and place the fertiliser in the furrow made. Alternatively the knocker type fertiliser machine may be used. This is similar to a mealie planter, is drawn by one mule, and deposits the fertiliser below the surface.

The various aspects of fertilisation that have been discussed above, apply only to the applications during the first year of growth.

For fertilisation in the second year, aerial application is recommended. This is more expensive than by hand but not prohibitively so. It has the advantage that fields can be treated when the cane is too big for hand work and also enables very large areas to be done when conditions are right.

A rough guide to the adequacy of the fertiliser methods on a sugar farm, is the cost of fertiliser used per ton of cane produced. If this figure is below five shillings per ton, then the planter is not applying enough fertiliser. If the analysis of the soil shows that fertiliser costing up to ten shillings per ton of cane produced is required, it should be applied without hesitation as the extra yield from fields so treated will more than pay for the cost of the fertiliser. The use of straight fertilisers instead of mixtures is more economical, these can always be mixed on the farm to suit individual requirements.

In all fertilisation it should be borne in mind that much fertiliser can be lost by being taken up by weeds, and no fertiliser should at any time be applied to fields in which weeds are growing or where it is not possible to keep future weed growth under control. When the writer was overseas recently visiting other sugar producing countries, he was greatly impressed by the lack of weeds in all cane fields. Nothing like what is called a "weedy field" in South Africa was seen anywhere. When opening a special conference organised by the Department of Agriculture on February 11th 1959 in Maritzburg, Mr. H. H. Cornell[3], Natal's Director of Agriculture, stated, "I was struck in 1953 when I was in Europe by the absence of weeds. The motto overseas was to catch the weeds young and treat them rough. A farmer once mentioned to me as I was being taken over an English farm, that something would have to be done about the weeds. I could not see them with my South African eye. But they were there—only just coming through the ground. In Europe they tackle them young, whereas we wait for the blackjacks to stick to our pants before doing anything."

**REFERENCES**

[1] C. D. Sherrard: "Notes on Sugar Cane for Beginners. S.A. Sugar Technologists' Conference, 1949.

[2] W. H. Patrick, Jr., and Mr. B. Sturges: "Report of Projects Dept. of Agronomy, Louisiana State University 1956", page 78.

[3] H. H. Cornell: "The Natal Mercury", 11.2.59.

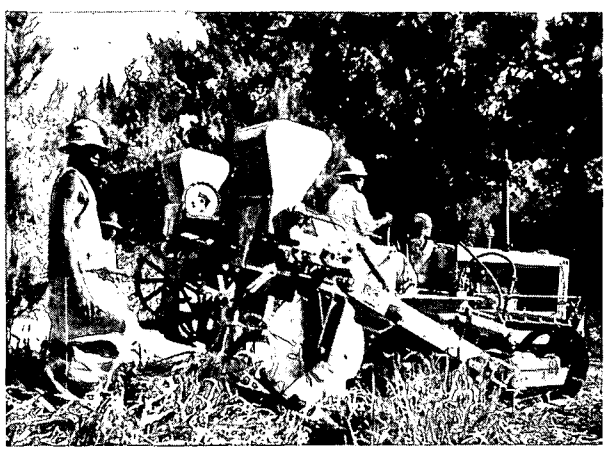

Fig. 1

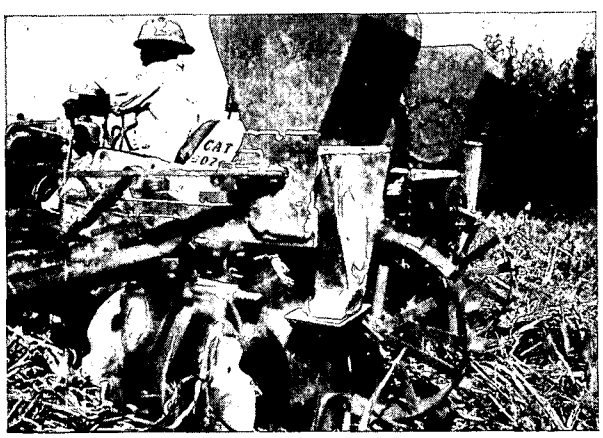


Fig. 2

**Mr. du Toit** (in the chair) opened up the discussion by saying that it was obvious that whether fertilization was used or not, weeds had to be kept under control.

**Mr. Lintner** wanted to know whether there had been leaf analyses and soil analyses done for the determination of the availability of phosphate.

**Mr. Steward** replied that soil analysis had, but no leaf analysis had been done. He said it appeared more beneficial to place the phosphate under the surface than on the top of the soil and he recommended this practice to planters.

**Mr. Pearson** commented that the statements had been made about increases due to high rainfall and to the use of fertilizer. He went on to mention the case of one particular field at the Experiment Farm where the yields were: cane planted in 1950, yielded 52 tons per acre as plant cane in 1952, the first ratoon crop was 48 tons, the second ratoon 42 tons, the third in 1958, 57 tons per acre. The rise was apparently attributable to rainfall alone. In 1952 the crop had only twenty-four inches of rain, the next crop had ninety-five inches, and the next crop had sixty-two inches, and the last crop had one hundred and six inches of rain. The fertilizer dressings were uniform the whole way through, so that the rise was probably due to the amount of water. He said that work was done very many years ago at the Experiment Station where the movement of phosphate in the soil was estimated at about two inches. In one trial where the placement of fertilizer had been studied in sandy soil, various methods of application were tried out. Three treatments were made: control, sulphate of ammonia, and H. mixture, which contains phosphate. The final results showed that increases in yield were obtained from dressings of nitrogen but where trash was present a further increase was obtained from the H. mixture which could be attributed to the phosphate. No increase was recorded for the phosphate when the treatment did not include trash.

**Mr. Smeaton** wanted to know the amount of fertilizer applied to the crops he had mentioned.

**Mr. Pearson** replied that P. and K. were applied in two dressings at 150 lb. per acre and then at 100 lb. per acre.

**Mr. du Toit** said that he did not feel that good yields were entirely due to fertilizer. He went on to say that it was a general conclusion that the rainfall had been responsible for the increase in the crop at Chakas Kraal. He thought that increased fertilization and the increased rainfall both were contributing factors to the good crop which was produced last year. He said that we had never had two successive years with as good a rainfall than we had experienced for the crop which had just been harvested.

**Mr. Steward** said that the figures showed that at Kearsney they had had two other successive growing seasons with very good rainfall.

**Mr. du Toit** said that he was quite prepared to accept that this could apply to certain individual areas, but the records kept by the Experiment Station applied to the whole Industry, and that the last two years were the best two successive ones that we had ever experienced for rainfall.

**Mr. Palmer** asked if the D-2 tractor could sub-soil to a depth of eighteen inches. He said that he had tried to do this with the D-4 and found that this unit could not move the coulters at a depth of eighteen inches.

**Mr. Steward** answered that the coulters did not go to that depth but the subsoilers did, even when pulled by a D-2 tractor. He said that although the soil was not hard, one had to stop operations under dry conditions and wait for rain. He said that a D-2 was capable of performing these operations only under favourable conditions.

**Mr. King** said that he had seen good responses at Huletts with deep placement of fertilizer. He said that Mr. Steward had made the statement that fertilizer would be of more value if it was applied directly to the roots of the cane. He said that the new roots developed by the ratoon crop were not dependent upon the old roots of the plant cane. He could not see how the placement of fertilizer at a depth of eighteen inches could be near the roots formed by the new cane. He wondered if the increase in yield due to this practice, might also not be due to some factor about which we knew nothing. In a dry season if the fertilizer is deeply placed, the roots would never be able to reach it. He thought that perhaps the sub-soiling itself could have caused the beneficial effect. He wanted to see experiments carried out where results of sub-soiling with and without fertilizer were compared.

**Mr. Steward** said that he had quoted the findings made by the Department of Agronomy, Louisiana State University, and he went on to say that he would like to know where one should place fertilizer, if it was correct that, at some stage, the plant had no roots at all.

**Mr. King** replied that he thought the subject required further investigation.

**Mr. du Toit** said that he also felt that sub-soiling may have had quite a lot to do with the results. He mentioned that he thought that Dr. Shuber intended to carry out an experiment where sub-soiling would be tried without fertilizer, and with fertilizer, and from this might come a clearer picture. He thought it strange that fertilizer should be placed so deep in sandy soils. He pointed out that in Louisiana the silt was very much heavier than our soils. He referred to Dr. Cleasby's paper and said

that with molasses application it was disconcerting that the potash disappeared so quickly. After the first crop, an amount of potash could not be accounted for in either the crop or the soil, and he thought that it had apparently moved down.

**Mr. Steward** said that it was a fact that weeds could not get at the fertilizer if it was placed deeply in the soil. He said that he considered that weeds removed a lot of fertilizer and that if this had been placed far enough down, it could not have been reached by weeds.

**Mr. Bachelor** wanted to know how fast the change-over took from the old cane roots to the new ratoon roots. If we knew more about this change-over, we might be in a better position to answer the queries about placement of fertilizer.

**Dr. McMartin** said that there appeared to be an overlap between the old roots and the new system, and he thought that the new roots would be feeding as soon as they were produced. The old ones kept on functioning for perhaps as long as two months; this would depend upon climatic conditions, soils, and the like. He commented on Mr. Steward's contention that the adequacy of fertilizer could be measured by the cost of the fertilizer applied and he considered this to be one of the most important points which planters should watch. Soil and leaf analysis was all very well, but the planter had to foot the bill for the fertilizer. Mr. Steward stated that if less than 5s. worth of fertilizer was applied, this would not be sufficient. This figure was very much higher than that to which growers had been accustomed. He wondered if it were economical that if fertilizer requirements were as much as 10s. per ton, that they should be applied. He thought this depended upon the area and that one could not compare areas producing twenty-five tons per acre with those producing sixty tons per acre.

**Mr. W. Hempson** said there were some areas where they did not apply fertilizer at all because the soils were rich enough now. The amount of money to be spent on fertilizer depended upon various conditions and this question had to be considered very carefully from the economic point of view.

**Mr. du Toit** said that he also considered that it depended upon a lot of factors on how much money should be outlaid on fertilizer. It also depended upon the distance of the cane from the mill and the costs involved to transport the extra cane which was produced. He considered it more economical to fertilize soils nearer to the mill, or areas where the cost of transport was low.

**Mr. Larsen** asked if he would be correct in saying that the old roots had absorbed whatever goodness there was in the soil and they would therefore die back quickly.

**Dr. McMartin** said that the root replacement in growing sugarcane was continuous. The root system of the old plant would die off because it was deprived of a top. The rate of decomposition of the root system depended upon climatic factors. In our our coastal lands, organic matter was totally decomposed in three months and he thought that this would apply to the old roots of the cane as well and would not depend upon the nutriment available.

**Mr. Smeaton** asked if Mr. Steward had tried the application of nitrogen to the plant cane before it had been cut for setts. He went on to say that he had tried this out with apparently very good results. He suggested that before the first rains one should give a liberal dressing of nitrogen to the seed cane. He said that apparently it enhanced the germination quite a lot. About the point of the amount of money to be spent according to analysis, one should remember when the samples were taken and the particular conditions applying to one's own farm. He said that the first roots formed by the ratoon crops would show deficiencies which became obvious in the cane leaves.

**Mr. du Toit** said that the young ratoons often showed up deficiencies, particularly trace element deficiencies, and that this might be due to their very shallow root systems. He said as the roots went deeper the deficiencies very often disappeared.

**Mr. de Robillard** said that the placement of fertilizers depended upon how deeply the cane was planted, but that they had no experiments with the combination of fertilizer and shallow or deep planting.

**Mr. Steward** said that generally speaking he favoured deep, and not shallow, planting.

**Dr. Dick** quoted the results of an experiment at Chaka's Kraal which demonstrated how great a loss in yield could be caused by heavy weed infestation. Where clean plots had produced forty-five tons cane per acre, infested plots had yielded only eleven tons. The method of weeding, whether chemical or mechanical, had not influenced the results.

**Mr. Palmer** said that at Empangeni at the present moment a serious drought was being experienced and that all ratoons had been top dressed. He wanted to know what could be expected of the fertilizer which had been applied. Had it been lost or would it be taken up when the rains came?

**Mr. du Toit** said that he considered there was no doubt that the fertilizer would still remain in the soil. He considered the only drawback was that the weather would soon be getting cold and then the growth even with fertilizer would not be so great. He did not consider that in the heavy soils at Empangeni, the loss due to leaching would be very great. He said that it had been found that after top-dressing at the normal time and an unseasonable

drought such as now experienced, the cane seemed to have suffered a bit more from the drought; this, he thought, was generally only just a passing phase and provided rain was forthcoming the crop would thrive.

**Mr. Sherrard** said that recently very heavy dressings of fertilizer had been recommended by fertilizer firms. He also pointed out that sometimes such heavy dressings were applied and no responses were obtained. He wondered if the responses obtained were really due to the heavy rainfall and not to the heavy applications of fertilizer. There were no concrete field experiments to back up the statements made by Mr. Steward.

**Mr. du Toit** agreed that the rainfall had a lot to do with the increase in yields as well as the increased use of fertilizer. He also pointed out that better and newer varieties of cane were planted. When one considered the overall picture of the agriculture say of Holland, and the amounts of fertilizer used there, we were using little. We were not yet spending 5s. per ton on fertilizer, and he considered that this amount was a reasonable figure to outlay. He said that if a crop was suffering from a serious deficiency of some sort, an amount in excess of 5s. would have to be outlaid. He pointed out that spending an uneconomical amount on fertilizer had to be guarded against. There were experimental results available which indicated that a higher level of fertilizer was an economical proposition. He considered 400 lb. of ammonium sulphate to be inadequate under our present conditions and with the present varieties of cane. Perhaps the varieties which were at present being grown in this country responded better to fertilizer. He again stressed that it was beyond a reasonable doubt that fertilizer as well as rainfall had played an important part in last year's yield.

**Mr. Smeaton** said that he had applied up to 1,000 lb. of ammonium nitrate per acre and this did not show a response until the potash level was also increased. He had found that only until 500-600 lb. of muriate of potash was applied, did good results materialise.

**Mr. du Toit** said that he considered Mr. Smeaton had referred to a most important aspect of fertilizer application. He said that the interaction between the various fertilizers was very important, but he considered that phosphate might now be somewhat neglected and that balanced fertilizing should always be used in order to get maximum economic returns. He considered that Mr. Smeaton's tests gave the correct indication.

**Mr. Pearson** said that in one experiment at Chaka's Kraal, large amounts of sulphate of ammonia were applied with a dressing of phosphate and potash. The best results were obtained with applications of 1,500 lb. of sulphate of ammonia. Results showed that so far nitrogen was of benefit in plant and first ratoon crops in mist-belt and table mountain soils.

**Mr. du Toit** said that one experiment should not be used as a guide to all planters to apply heavy dressings of fertilizer, but 400 lb. of ammonium of sulphate had been shown to be too low. The Chairman said that he was pleased to see so many growers present, and he felt that this was largely due to the fact that papers had been given with a practical basis.