THE POSSIBILITIES OF LEGUMINOUS CASH CROPS IN THE NATAL SUGAR BELT.

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The question of obtaining suitable cash crops other than a few staple crops such as sugar, maize, kaffir corn, wheat, etc., for various localities has always been a difficult one; in fact, in many cases an unsurmountable one. Where soil and climatic conditions are found to suit a particular crop, economic laws most often make the production of such a crop prohibitive.

Cost of production, transport facilities, and, last but not least, markets or demand, are limiting economic factors. Our local consumption, as is well known, for most agricultural commodities is very restricted, and on the export market we are invariably faced with competition from countries which are able to produce on a larger and/or cheaper scale.

At the present moment there are only a few minor crops which, although subject to price fluctuations, can be regarded as fairly reliable cash propositions, and it should be comforting to know that they can be grown under the conditions with which we here are concerned, i.e. on the coastal belt of Natal.

Root crops, like potatoes, sweet potatoes, madumbies, further, beans, peas, peanuts and—since we are off the gold standard—also soya beans fall within the range of these minor cash crops. This paper is confined to the possibilities of the leguminous cash crops, and will therefore centre around the last four named crops, e.g. beans, peas, peanuts and soya beans.

From the outset is should be clearly understood that while there are outside possibilities for these crops, large scale cultivation is not advocated—anyhow, not until definite and payable export markets are established. Production in a small and profitable way, with the legume fitting into this present-day system of sugar farming, is the object that should be aimed at. A certain acreage of cane is re-established every season. Is it not possible to have the old cane removed and the land ploughed about November, ready for the planting for the legume? These would occupy the land, or part of it, from about November till May, giving the soil the benefit of their soil-improving characters and leaving it ready for the re-establishing of cane the following summer. Such practice, if it can be carried out, would seem to have a decided future.

On the other hand, there might also be a chance of growing the legume in between the rows of the ratoons during the summer, after cutting. Competition factors, both from a moisture and plant-food point of view, enter here, and it is difficult to say how the scheme would answer, but it may be quite feasible.

Then there is, of course, the possibility of specially reserving a piece of land for the purpose of growing additional crops. It is quite likely that this alternative might have to be considered. Lands which for some reason or other are not suited to sugar, either for physical fertility or economic reasons, might be quite profitably put down to a legume and in time be brought to the correct standard for economic sugar production.

It may be argued that these marginal lands, if not suitable for sugar, will not be suitable to raise other crops profitably. But then one should remember that legumes, on the whole, are better suited to poor conditions than practically any other crops, provided, of course, the legume can act properly and form nodules. Although the discussion of nodule formation diverts somewhat from the scope of this paper, it is nevertheless most interesting and intimately connected with the possibility of growing legumes profitably. It will therefore not be a waste of time to wander into the field of legume inoculation for a while.

Legume Inoculation.

Organisms known as nitrogen fixing bacteria live in the nodules often found on the roots of legumes such as cowpeas, soya beans, lucerne, vetches, lupins, etc. The leguminous plant furnishes the bacteria with food (sugar and mineral matter), and in return the bacteria extract nitrogen from the atmosphere and turn it over to the plant in a desirable form. The presence of the nodule-forming bacteria in a soil results in the formation of nodules on the roots of the plants. This has come about gradually through years of legume growing. These bacteria gain an entrance when they come in contact with the fine roots of the plant. They enter and make the plant build them a home. Here they grow and multiply rapidly, until finally a nodule is formed. Nodules on different legumes show variation in shape and size. The nodules on lucerne are club-shaped; on clover, small and oval; on soya beans, comparatively large and round. Other growth on plants are sometimes mistaken for nodules, particularly the gall caused by eelworm. This is really a swelling of the root and is solid to the touch. The true nodule produced by the bacteria is rather fragile and collapses readily if pressed between the fingers. Soil drainage and ventilation are absolutely necessary for growth of bacteria.

The necessity for inoculation of any leguminous crop can only be ascertained by growing the particular crop and examining the roots for nodules. If no nodules are visible, or only a few, it will be necessary to resort to inoculation by means of pure cultures or inoculated soil.

Natural inoculation is a slow process, as although inoculation will come about as a result of growing the same leguminous crop in the same land for several successive seasons, there is in the meantime a heavy demand on the soil nitrogen. This depletion can be obviated by inoculating the seed and enabling the plant to obtain a portion of its nitrogen from the atmosphere. In plants from inoculated seed the nodules appear early, and are either evenly distributed over all the roots or clustered together in a small area near the crown. If the bacteria are sparsely and widely scattered, nodules appear at a later period on the lateral roots. The earlier the nodules are formed the more nitrogen will be fixed, as a rule. The bacteria of most legumes do not like an acid soil, although soya beans and lupins are fairly tolerant. The application of lime in the form of limestone has a favourable influence on the development of the nitrogen fixing bacteria in sour soils. Bacteria spread most quickly in a sandy or light soil and most slowly in heavy soil. The bacteria will live in the soil free from legumes for many years, provided the soil is not sour—in the latter case they will disappear rapidly. If lime is present the bacteria will last long enough to enable a rotation scheme to be carried out, using a legume every third or fifth year. In favourable conditions nitrogen fixing bacteria have been found in soil seventeen years after the host plant has been removed.

Early maturing varieties of legumes show nodule production much sooner than the late maturing varieties.

There is a difference in the efficiency of different strains of bacteria.

Bacterial activity goes on to a depth of 4 to 5 inches. It has been found that, other things being equal, a high soil temperature produces the maximum of bacteria.

The supply of nitrogen in the nodule is greatest when the plant is just ready to blossom; when the legumes begin to form seed the nodules cease to grow, shrink, and eventually decay—returning the bacteria to the soil. All legume root nodules are annual growths on both annuals and perennials. Non-leguminous crops such as maize, etc., following an inoculated leguminous crop give increased yields.

Well inoculated legumes give increased yields over non-inoculated legumes, and the plants contain a higher percentage of nitrogen, giving them greater feeding value. An appreciable gain of nitrogen is shown in well inoculated soils. Limestone stimulates action of bacteria and assists fixation of nitrogen. Nodular bacteria will withstand comparatively low temperatures.

Investigations relative to the value of legumes and the advantages of soil inoculation have been carried out at Cedara for several years. Experiments have shown that the use of a legume in a rotation of crops has resulted in an increased yield of the crop following (maize), and this effect has been apparent for at least two seasons. Both cowpeas and soya beans have given excellent results. It was found necessary to inoculate the soya beans. Experiments carried out in the inoculation of soya beans on a plot culture basis and a field basis show increased yield of soya beans in inoculated sections over soya beans grown in uninoculated sections. The inoculated sections also showed a greater proportion of seed to plant. The benefits of limestone are very clearly indicated—limed plots proving consistently better than unlimed plots. The influence of limestone on nodulate production is most marked. Inoculation also shows marked improvement in lucerne growth.

A wide range of leguminous crops has been dealt with. Cowpeas, mung beans, adsuki beans, lupins, vetches, field peas and the clovers have produced nodules without recourse to inoculation. Lucerne, Hubam clover, and field beans and soya beans required inoculation. All the legumes now growing in the experimental area show nodular development, including Kudzu vine, seradella and Lespedeza. Inoculation was carried out with pure cultures.

A large amount of inoculated soil has been taken from our soya bean section and distributed to farmers for purposes of soil inoculation.

Certain strains of nodule bacteria inoculate one kind of legume only, other strains cross-inoculate. Different legumes require different bacteria.

The same kind of culture will inoculate red clover, Alsike, crimson and white clover. The same kind of culture will inoculate lucerne, Hubam clover and yellow sweet clover.

The same kind of culture will inoculate field peas, garden peas, vetches, lentils, sweet peas. The same kind of culture will inoculate cowpeas, peanuts, Japan clover, velvet beans, lima beans. The same kind of culture will inoculate field beans, garden beans, scarlet runners. The same kind of culture will inoculate lupins or seradella.

To inoculate soya beans use only the bacteria from soya bean culture.

The following methods of soil inoculation are commonly practised:—

1. The use of pure cultures.
2. The use of inoculated soil (glue method).
3. The use of inoculated soil (soil transfer method).

Pure cultures consist of the nodular bacteria which have been isolated from the legume nodule and which are propagated in a nutrient solution, or on some jelly-like material such as Agar, or in sterilised earth or peat. All three types of culture are on the market, in bottles or tins sufficient to inoculate one bushel of seed. Some cultures are in containers holding sufficient to inoculate larger quantities of seed. Cultures are comparatively simple to use, but the instructions must be rigidly adhered to.

The Agar type are contained in bottles with special stoppers and are only partly filled. The bottle is filled up with clean water and agitated thoroughly, the bacteria contained on the side of the Agar being washed off and taken up by the water. This process is repeated with fresh lots of water until sufficient fluid has been obtained to slightly moisten the whole quantity of seed. This fluid is poured on the seed and thoroughly mixed with it so that all seeds are damped. The seed is allowed to dry slightly and is ready for sowing. It should be used at once if possible, as if kept any length of time it loses its inoculation efficiency. If kept over ten days the seed will require to be re-inoculated.

Sterilised earth or peat cultures are usually mixed with about a pint of water and thoroughly mixed with one bushel of seed. In purchasing pure cultures see that there is a date stamped on the label stating for what period the culture is efficient.

The efficiency of the culture treatment will largely depend on well tilled soil; healthy seed; a sufficiency of phosphates and potash; the presence of lime (limestones).

On no account must inoculated seeds be exposed to the direct rays of the sun. The sun will kill the bacteria; nor must the seed be brought in direct contact with quicklime, slaked lime or superphosphate.

Inoculated soil can be used in conjunction with glue. Inoculated soil is obtained in the neighbourhood of plants which have produced a prolific supply of well-developed nodules. The top surface of the soil is cleared away and weeds removed. The soil is taken to a depth of about 4 inches and carefully sieved. A solution of glue is made, about ½lb. to 1 gallon of water, and allowed to cool. The seed is spread out and moistened with the glue solution. The inoculated soil, in a comparatively dry condition, is scattered over the seed and the seed mixed with it until each seed has a coating of soil. The seed must now be dried away from the sun. It can be kept for a time, but it is recommended that it be sown as soon as possible after it has been treated and dried.

Inoculated soil placed in drill with seed (soil transfer): take inoculated soil as directed for glue method, sieve it thoroughly to free from weeds and store in sacks away from the sun until required. It can be employed in a variety of ways, i.e. by broadcasting and harrowing-in, by hand distribution in open drills, by means of fertiliser attachment on the planting machine.

Experience shows that the broadcasting method is not uniformly successful. If this operation is carried out in bright sunlight some of the bacteria will be killed, so that it will be necessary to broadcast on an overclouded day and harrow-in immediately. Broadcasting does not bring the seed and the inoculated soil into direct contact, so that no action takes place until the rain has carried the bacteria into the soil and established contact with the seed.

The transfer of soil through the fertiliser attachment of the planter is the method likely to give the best results. This immediately establishes contact with the seed. At least two bags of inoculated soil per acre could be used. Fertilisers in this case will have to be broadcasted and harrowed-in. When commencing to inoculate land with a view to its adoption on a large scale in a rotation scheme, it will be advisable to start with a small area. A site should be selected near the homestead of an area of half an acre. Hand-drills should be made about 2½ feet long. Limestone should be applied in drills at rate of 1,600 lbs. per acre. The seed can now be shown in the drills at rate of 60 lbs. per acre. A thin layer of inoculated soil being distributed on the top of the drill, and this is then closed.

Fertilisers can be applied before seeding, care being taken to mix them thoroughly with the soil at the bottom of the drill. In order to ensure the complete inoculation of the section, the same variety of legume should be grown in the same land for a succession of seasons. This section will form a breeding plot for nitrogen-fixing bacteria and will enable anyone to use the soil to progressively inoculate his arable lands.

In the case of an established section of lucerne, inoculated soil should be well harrowed-in. The cause of failure to secure successful inoculation may be: (1) extreme acidity of soil; (2) lack of proper tilth of soil; (3) bad seed; (4) exposure of inoculated seed to sun's rays; (5) failure to promote contact between inoculated soil and seed; (6) scarcity of phosphates and potash in the soil. If these causes are remedied and care taken, the inoculation of the soil will not be difficult of accomplishment.

The soil transfer and glue method both contain a serious danger, e.g. that of transferring soil-borne diseases and pests such as rots and eelworm from a disease-infected area to a healthy land. For this reason, preference is given to the culture method. It is rather surprising, but it very often happens that eelworm growths are mistaken for nodules. If one remembers that the nodules adhere to the root and that, on the other hand, the eelworm growth forms a definite part of the root, the differentiation between the two should not be too difficult. The knowledge of this distinction is of vital importance to the farmer.

From this discussion on legume inoculation it will be seen that legumes, if given proper growing conditions, are admirably suited for rotation and soil improvement purposes, by no means a small consideration in sugar farming, where both these phases are not always easily applied.

After this preliminary discussion on the possibility of legume growing, we now come to various economic and cultural considerations in connection with the crops suggested as cash crops for the sugar belt.

Beans.

This crop can be utilised in two forms, viz., as green beans and as dry beans. It seems doubtful whether it is sound to recommend the exploiting of the first source in view of the competition from market gardens. There are, however, times when green beans fetch good prices, especially in the autumn and winter where moisture conditions permit of such late production, the sugar farmer might give the matter some thought.

With dry beans the position is somewhat different. Practically throughout the year this article commands high prices, and particularly where varieties such as white haricot and sugar beans are chosen the venture of dry bean production should be a profitable one. A general complaint on the dry bean market is discolouration and shrivelling of the beans. These faults can very often be associated with ripening-off under wet conditions. It is here where the coastal farmer should be able to score by being able to plant fairly late, e.g. towards end of January and February, enabling the beans to mature in drier and more suitable weather. The care of the crop is an easy one. The beans are planted usually with a maize planter fitted with special plates. Cultivation, especially in the young stages, is very essential and beneficial. Harvesting is accomplished by either pulling or cutting the plants. On the field scale it will be readily understood that dwarf or semi-dwarf types will have to be planted, as the supporting of climbing varieties with sticks is an expensive item.

The average yield for field beans in this country is very low, somewhere in the vicinity of three bags per acre. With the right management and correct fertiliser treatment, yields should be considerably increased.

It is often argued that by pulling out the plants when harvesting the nodules are taken out of the ground and thus the nitrogen supply with them; but this is not so, as the excess nitrogen (nitrogen bacteria) by that time have already gone back into the soil.

Field Peas.

Again, as with the field bean, we are faced with two aspects, green and dry pea production. With the commodity in the green state the position is somewhat similar to that of the green bean. At certain times it will pay to sell green peas, but a stable and reliable market will only be found with the dried pea. Varieties which have proved to be suited to the existing conditions, both from a yield and disease point of view, are

Stratagem, Yorkshire Hero and Blackeyed Susan. There are, of course, many more varieties, such as G. F. Wilson, Omega, Ne Plus Ultra, etc., but according to the data obtained by the Cedara horticulturist, Mr. Geo. Terry, the first-named varieties have proved their worth beyond doubt, and should be seriously considered. Cultural methods are similar to those of beans and should not present much difficulty.

Soya Beans.

This crop is in a somewhat different position to the two previous ones. Local consumption is very limited, and the only hope of an extended and profitable production lies in the opening up of export markets. The Union Government has been in touch with overseas authorities, and samples of South African grown soya beans have been received very favourably. They are said to compare favourably with the best produced in Manchuria and U.S.A. Whilst the quotation of £8 8s. 0d. c.i.f. London some months ago was not tempting owing to this country being on the gold standard, the position to-day certainly looks more rosy and hopeful.

Soya beans are very easily grown, the cultural operations being the same as those required for beans. As many as 20 varieties have been tested at Cedara and yields as high as 12 bags per acre have been obtained. Varieties such as A.K., Mammoth, American White, Chinese White and Brownie have been the most successful. Brownie tops the list as a seed yielder. As the name indicates, it is a brown bean. The other varieties range in colour from white to green. While with other legumes the nodule-forming bacteria are often present naturally in the soil, the soya bean bacteria are entirely absent in South African soils, and thus inoculation is necessary on such lands as receive the crop for the first time.

Shattering of seed is often experienced in the drier areas, but in Natal this difficulty has not been experienced to any extent. As with beans and peas, shelling can be done in various ways, ranging from a special bean sheller to hand threshing.

Peanuts or Ground Nuts.

While the price of maize and perhaps also sugar during recent years went down to a level out of proportion to the cost of production, the ground nut has been able to maintain satisfactory returns. In many cases it has been a saving standby for farmers situated in areas where the crop can be grown profitably. Owing to the many by-products—peanut butter, peanut oil, etc.—local consumption is satisfactory. An alarm message went through the Press the other day stating that the peanut industry of this country was being seriously threatened owing to the high inland freight rates from the inland centres of production to the coast where factories are established, thus enabling other countries to compete favourably.

Whatever the case may be, the coastal belt farmer will not be seriously affected. In the growing of the crop, which again resembles the previous ones, there is perhaps one phase worthy of mention, e.g. the curing of the nuts before picking. Many a crop has been spoilt through faulty handling at this stage.

It is the usual practice to lift the plant, nuts and foliage together, and then to cure the plants in wind rows. While in fine weather the results of this procedure are satisfactory, in bad weather both nuts and plants easily deteriorate.

It is therefore suggested to adopt the method of building small stacks around the pole, approximately 7 feet long, across which two cross-pieces of about 14in. to 18in. are nailed, about 12in. from the ground. The plants are stacked around the pole, always keeping the nuts inside and giving the plants a slight slant in order to allow rain water to shed better.

This method is very reliable and will always result in well cured nuts and plants. Peanut hay is a nutritious and palatable stock feed.

While it was not possible to deal fully with the subject under discussion, particularly from the cultural aspect, it is hoped that the Natal sugar farmer will see certain possibilities ahead of growing legumes profitably as cash crops in the sugar belt.

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CHAIRMAN: We have to thank Mr. Schultz for his valuable contribution to the other two excellent papers you have heard this morning. I would like to express regret that more planters did not take the opportunity of coming in to listen to these papers which are provided for them. Unfortunately our time is short, and I am afraid there is not time for you to ask Mr. Schultz any questions. I will therefore ask you to show your appreciation of his paper. (Loud applause.)